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The Franklin Institute Research Laboratories, Science Information Services Department prepared for the Environmental Protection Agency, Volume 3 of a monthly current-awareness abstracting bulletin, Municipal Technology Bullentin, which dealt with methods of municipal waste water treatment, problems of water quality, and water pollution control. Volume 3 of the Bulletin contained abstracts of technologically significant literature appearing in print between April 1975 and March 1976. Under the same grant, the Science Information Services Department provided abstracts, including those appearing in Volume 3, to the Water Resources Scientific Information Center (WRSIC) as a center of competence on municipal waste water for WRSIC. Topics covered in the Bulletin and in the WRSIC input include: analytical techniques for water quality measurements; biological, chemical, and physical methods of waste water treatment; construction and equipment for pollution control; mathematical, statistical, and simulation model studies; storm runoff, tunnelling technology and sewer systems; and, treatment plant operation and automation. This report is a compilation of the abstracts arranged in chronological order by accession number within subject categories.

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MUNICIPAL WATER POLLUTION CONTROL ABSTRACTS: APRIL 1975 - MARCH 1976

By

Joanne S. Murphy

Janet R. Orr

and

Rochelle P. Kramer

Project Officer

Henry Thacker, PhD.
Municipal Pollution Control Division
Control and Treatment Integration Branch
Environmental Protection Agency
Washington, D.C. 20460

Prepared for
Office of Research and Development
U.S. Environmental Protection Agency
Washington, D.C. 20460

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ABSTRACT

The Franklin Institute Research Laboratories, Science Information Services Department prepared for the Environmental Protection Agency, Volume 3 of a monthly current-awareness abstracting bulletin, *Municipal Technology Bulletin*, which dealt with methods of municipal waste water treatment, problems of water quality, and water pollution control. Volume 3 of the *Bulletin* contained abstracts of technologically significant literature appearing in print between April 1975 and March 1976. Under the same grant, the Science Information Services Department provided 1800 abstracts, including those appearing in Volume 3, to the Water Resources Scientific Information Center (WRSIC) as a center of competence on municipal waste water for WRSIC. The *Municipal Technology Bulletin* informs researchers, consultants, engineers, and government officials of current developments described in more than 7000 scientific and technical publications, both domestic and foreign. Topics covered in the *Bulletin* and in the WRSIC input include: analytical techniques for water quality measurements; biological, chemical, and physical methods of waste water treatment; construction and equipment for pollution control; mathematical, statistical, and simulation model studies; storm runoff; tunnelling technology and sewer systems; and, treatment plant operation and automation. This report is a compilation of the 1800 abstracts arranged in chronological order by accession number within subject categories. A list of the abstracts which appeared in the *Municipal Technology Bulletin* is provided. Also included are a subject index, author index, and journal list.

Municipal Water Pollution Control Abstracts: April 1975-March 1976 is submitted in fulfillment of grant number R803613-01-0 by The Franklin Institute Research Laboratories under the sponsorship of the Environmental Protection Agency. Work on this project was completed as of April 30, 1976.

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INTRODUCTION

In order to facilitate the absorption of the large amount of current literature dealing with municipal waste water collection, treatment, and disposal, the Science Information Services Department of The Franklin Institute Research Laboratories abstracted, categorized, and indexed the literature which appeared in print between April 1975 and March 1976, inclusive. This service was made possible through a grant from the Environmental Protection Agency's Office of Research and Development. Abstracts of technologically significant articles were highlighted in Volume 3 of the *Municipal Technology Bulletin*, a monthly current-awareness abstracting bulletin. The abstracting service concentrated on the following major subject areas as related to municipal waste water: analytical techniques; sampling and instrumentation; hydrologic aspects; legislation; model studies; patents; sewer systems; treatment methods; and, tunnelling technology. A total of eighteen hundred (1800) abstracts, including the 338 appearing in Volume 3, were input to the Water Resources Scientific Information Center (WRSIC), Office of Water Research and Technology, Department of the Interior. The present report is a fully indexed compilation of these 1800 abstracts and serves as a specialized yearly bibliography on municipal waste water control.

The *Municipal Technology Bulletin*, Volume 3, is the outgrowth of several preceding publications which were prepared by The Franklin Institute for the EPA: *Selected Storm Water Runoff Abstracts*, 1970-1972, and the *Municipal Technology Bulletin*, Volumes 1 and 2, 1973 and 1974. These publications were designed to meet the needs of officials, researchers, and engineers to stay aware of recent developments in this subject while spending a minimum amount of time scanning the literature themselves. Thus, the EPA awarded grants to the Franklin Institute to gather and disseminate this information. The abstracts of the *Municipal Technology Bulletin* provide a basis for further exploration of the relevant water resources literature.

Material for the *Municipal Technology Bulletin* was chosen by the regular scanning of over 7000 publications, both domestic and foreign. These documents are technical journals, government reports, industrial reports, newsletters, patent gazettes, design manuals, conference proceedings, recent

dissertations, and textbooks. The material was screened at The Franklin Institute Library and several other Philadelphia libraries. Additional screening was performed at The Franklin Institute's facilities in Munich, Germany, and Tokyo, Japan. Each month, 30 documents pertaining to the latest municipal technology were selected for inclusion in the *Municipal Technology Bulletin*. Specific subject areas covered were: (1) waste water treatment methods relating to facilities, land application, utilization of sludge, waste water reuse, plant automation, mechanical and chemical devices; (2) biological, chemical, and physical analytical techniques; (3) storm water runoff, including urban runoff, runoff forecasting, flood routing, rainfall-runoff relationships, catchment basins, and surface runoff; (4) sewer systems, including combined, separated, outfall and interceptor sewers, storm drains, infiltration-inflow, materials and equipment; (5) patents for methods and equipment pertaining to waste water treatment, waste water reuse, and waste water disposal; (6) mathematical, statistical, or simulation model studies; and (7) hydrologic aspects involving parametric hydrology, sewer hydraulics, and drainage.

In 1975 and 1976, the *Municipal Technology Bulletin* was distributed free of charge on a monthly basis to 660 selected recipients whose names were supplied by the EPA Project Officer, or who were added as a result of a direct request to The Franklin Institute to be placed on the mailing list. There was an increase of about 50 names over 1974.

Through this EPA grant, The Franklin Institute served as a center of competence for municipal waste water pollution control. Eighteen hundred abstracts on municipal waste water treatment methods were provided to the Water Resources Scientific Information Center (WRSIC). These were published in *Selected Water Resources Abstracts*, their semi-monthly abstracting journal, and were entered into their computerized data base. Literature was chosen for input to WRSIC using essentially the same criteria as for the *Municipal Technology Bulletin*, as well as the same screening procedures.

This report includes all abstracts which appeared in the *Municipal Technology Bulletin* and those forwarded to WRSIC. To improve the ease of using this publication as a specialized bibliography, an in-depth subject

index is provided, appearing in a hierarchical, computer-generated form. A complete author index and a journal list are also included. The abstracts are arranged chronologically by accession number within the subject areas. Topic headings are: Storm Runoff, Sewer Systems, Patents, Treatment Methods, Analytical Techniques, Model Studies, Hydrologic Aspects, and Miscellaneous. The format of each abstract is explained on the following page.

ABSTRACT FORMAT

FIRL ACCESSION NUMBER

TITLE OF ARTICLE

NAME OF AUTHOR(S)

AFFILIATION OF SENIOR AUTHOR

BIBLIOGRAPHIC DATA: Journal title (source), Volume, Issue number, Pagination, Date, Figures, Tables, References.

ABSTRACT

DESCRIPTORS: Those terms found in the *Water Resources Thesaurus* which best describe the concepts and content of the article. Asterisks denote the more relevant terms.

IDENTIFIERS: Those terms not contained in the *Water Resources Thesaurus* which also closely describe the article's content.

MUNICIPAL TECHNOLOGY BULLETIN ABSTRACT LIST

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		E012-E028	514-522
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C252-C256	185-187		
		H001-H006	692-694
D022-D039	199-208	H025-H027	704-705
D131-D135	254-256	H032-H037	707-710
D220-D225	298-301	H040-H042	711-712
D262-D268	319-322	H046-H049	714-716
D385-D390	381-383	H054-H055	718-719

MUNICIPAL WATER POLLUTION CONTROL ABSTRACTS

The following abstracts are arranged chronologically by accession number within each subject area. The subject areas are identified by a letter code:

A - Storm Runoff

B - Sewer Systems

C - Patents

D - Treatment Methods

E - Analytical Techniques

F - Model Studies

H - Hydrologic Aspects

J - Miscellaneous

A001
HYDROLOGIC IMPACT OF PLANNED UNIT DEVELOPMENTS,

McCuen, R. H., and Piper, H. W.

Maryland University, College Park, Maryland, Department of Civil Engineering

Journal of the Urban Planning and Development Division, ASCE, Vol. 101, No. UP1, p 93-102, May, 1975. 5 fig, 4 tab, 11 ref.

The hydrologic impact of planned unit developments (PUD) is examined. A linked-process hydrologic model was formulated to estimate the hydrologic impact of various land-use configurations and examine the potential of various storm water management practices. Components are included to simulate the various hydrologic processes such as interception, infiltration, evapotranspiration, surface retention and detention, subsurface flow, rooftop storage and runoff, overland flow on impervious surfaces, gutter flow and storm sewer system routing, which are involved in transforming rainfall to storm water runoff. Peak discharges from a planned unit development have been computed to be as much as three times those of a single family detached dwelling unit and five times those of undeveloped land use. This fact makes it imperative that storm water management alternatives for PUD be investigated. The linked-process hydrologic model employed in this study appears to be a valid means for estimating the hydrologic impact of PUD and the effect of various storm water management alternatives. The use of rooftop detention may reduce peak discharge by approximately 4%. However, parking lot detention appears to be a more practical detention alternative.

*Storm runoff, *Urban hydrology, *Urban runoff, *Model studies, Runoff forecasting, Urbanization, Infiltration, Hydrographs, Evapotranspiration, Subsurface flow, Roofs

Planned Unit Development, Linked-process hydrologic model, Rooftop detention

A002
CONTROLS DRY UP WET WEATHER POLLUTION,

Lager, J. A.

Metcalf and Eddy, Incorporated, Consulting Engineers, Boston, Massachusetts

Water and Wastes Engineering, Vol. 11, No. 9, p 35-37, September, 1974. 2 fig.

One of the most challenging tests of sanitary engineering skills is the development of methods for wet weather pollution control and abatement. System control and storage with feedback to existing plants, independent facilities and modified existing plants have been developed to meet these problems. The goal of system control is to optimize the containment and treatment of storm runoff. The actions taken are dependent upon the storm pattern, treatment and storage availability, and projected storm and system behavior. Mathematical models can be an important asset in the development and fine-tuning of these systems. Storage is one of the most cost-effective tools for the reduction of pollution resulting from combined sewage overflow, to improve management of urban stormwater runoff, and/or to lessen or end plant bypasses or process imbalances. Storage can be in-line damming, gating or otherwise restricting the flow passage in combined sewers that are designed to carry maximum flows that might occur once every five years. Storage can be off-line through the use of basins, controlled ponding, tunnels, and silos. The total systems approach may be impractical in some situations; immediate solutions may then be relatively limited purpose, independent facilities which will either be integrated or made obsolete by future construction. Examples of these facilities include: fine screening; microstraining; swirl concentrating; dissolved air flotation; physical-chemical treatment; and, disinfection. The storm runoff treatment processes of many United States cities are described.

*Storm runoff, *Combined sewers, *Waste water treatment, *Storm water, Cities, Water storage, Storm drains, Pollution control, Pollution abatement, Equipment, Facilities, Conduits, Sanitary engineering

A003
SELF-CLEANING STORM OVERFLOW BASINS WITH MEANDER DUCT (SELBSTREINIGENDES REGENUBERLAUFBECKEN MIT SCHLANGENRINNE),

Koral, J., and Saatci, C.

Wasserwirtschaft, Vol. 64, No. 10, p 301-306, October, 1974. 11 fig, 4 ref.

A design for the construction of a new and self-cleaning storm water tank is described. Solids which have settled during the precipitation are removed by dry weather flow, which crosses the bottom of the tank like a meander. This reduces the cleaning work of the tank. A pilot test of this construction has been done for six years continuously in Switzerland. The dimensioning and application possibilities are detailed. In addition, other examples have been presented to specialists and their opinions about possible problems with the method are given.

*Storm water, *Storm runoff, *Precipitation (atmospheric), Construction, Planning

Pilot tests, Switzerland, Storm water tank

A004
THAMES FLOOD PREVENTION STARTS QUIETLY WITH L2,000 PER METRE PROJECT,

Reina, P.

New Civil Engineer, No. 105, p 26-27, August 15, 1974.

A vast scheme in several parts is being implemented to protect land around the Thames River from floods. It is expected that by 1979 a barrier and walls will be completed to meet surge tides anticipated. Two working contracts focus on the GLC area; one is on the industrial north bank, east of the barrier and the other is on the spacious shore of Thameshead. Design and problems met have been so individual that one engineer has described the construction as yard by yard design. When possible, the ground retaining sheeting, capped by concrete walls, is tied back to rows of racking piles. Where pile driving is impossible, ground anchors are tying the sheets back. A Woolwich ferry jetty caused the special problem of a gap, which will be closed to flood water by sliding gates at ground level, with sheet piling beneath; the 12 m long sheet piles will be driven beneath the jetty in 4 m long sections and welded. Alternative tie designs are so frequent on this project that the longest stretch of continuous work is only 280 m long. Negotiations are ongoing as to how much the GLC should pay towards the construction cost outside its area for the downstream effects of barrier closure. The Thames barrier is an obvious piece of work, representing about 40 percent of the total investment, and its importance in view of the whole scheme of flood control is still being discussed.

*Flood control, *Construction costs, Construction materials, Design criteria, Flood protection

Thames River (England)

A005
STORMWATER POLLUTION--SAMPLING AND MEASUREMENT,

Tucker, C. G. J.,

Trent Polytechnic, Nottingham, Great Britain,
Department of Building and Civil Engineering

Journal of the Institution of Municipal Engineers, Vol. 101, No. 10, p 269-273, October, 1974. 6 fig, 1 tab, 10 ref.

The assessing of the nature of urban runoff pollutants requires the measurement of both flow and composition throughout a storm. It is important that automatic equipment measure the initial flow, where a first flush of pollutant often occurs. Various types of automatic control may be used, such as floats, static head transducers and pressure switches. Sampling may be done on a continuous or discrete basis at variable time intervals. Two methods of dilution gauging, constant rate injection and gulp injection, are used for measuring storm water, with a lithium tracer, since rainfall and runoff do not contain natural lithium. Described here is the method of gulp injection, controlled by an interval sampler which is activated by an automatic float switch. A mass of tracer solution is added to the flow in a gulp dose. The passage of the resultant pulse is measured downstream. Equipment is detailed; its installation in manholes is simple, so long as space is sufficient for sampler and doser to pass through a 21-inch manhole ring Results are given by storm hydrographs and concentration-time curves which are plotted to determine the polluting constituents. The integrated or Total Storm Load (TSL) value is found. This TSL is derived from a sum of the sampling intervals and represents the quantity of a pollutant which is washed by a storm from the surface water catchment.

*Urban runoff, *Storm water, *Measurement, *Storm runoff, Flow, Automation, Pollutant identification, Sampling, Hydrographs, Installation, Manholes

*Dilution gauging, *Gulp injection, Lithium tracer

A006
A REGIONAL APPROACH TO URBAN STORM WATER DETENTION,

McCuen, R. H.

Maryland University,
College Park, Maryland,
Department of Civil Engineering

Geophysical Research Letters, Vol. 1, No. 7, p 321-322, November, 1974. 1 fig, 4 ref.

Storm water detention has been required by law in many states. This may take the form of an individual site approach or a regional plan. The effectiveness of the individual site management has been challenged; the hypothesis tested was that installing detention devices only in newly developed areas may actually result in increased flooding. Three simulated hydrographs for ten storm events studied the conditions where no storm water detention facilities were provided on any of 17 subwatersheds; where detention facilities were provided on the 12 subwatersheds near the outfall, enclosing 51.4% of the total area; and where detention facilities were provided on all 17 subwatersheds. Conclusions were that the effectiveness of storm water detention facilities depends largely on the type of maintenance received. The hydrographs suggested that the individual site approach to storm water detention may actually create flooding problems instead of reducing the hydrologic impact of urbanization. It was also recommended that a regional approach to urban storm water management may be the most effective approach.

*Storm water, *Storm runoff, Urban runoff, Urbanization, Legislation, Simulation analysis, Hydrographs, Hydrology, Watersheds, Maintenance, Regional analysis, Flood control

*Storm water detention, Storm water management

A007
STORMWATER CONTROL KEY TO BAY POLLUTION SOLUTION,

Engineering News-Record, Vol. 193, No. 25, p 17-18, December 12, 1974. 4 fig.

A thirty-year master plan for the San Francisco Bay Area for collection and treatment works has been designed. The San Francisco system combines both sanitary sewage and stormwater, and each year an estimated six billion gallons of waste water escape treatment during storms. Out of $700 million alloted for this project, about $500 million would go for stormwater control. The total plan calls for over forty retention basins capable of holding up to 7 million cu ft of overflow for subsequent treatment. These basins will counteract unever patterns of flooding and pollutant loading that are caused by Pacific storms. Severe storms increase dry weather flow more than ten times. A computer system would control basin gates to match flow from the basins with treatment capacity. The overall plan aims at reducing the number of overflows by 90%. It includes: a new 1000 mgd treatment plant near Lake Merced to provide split-flow treatment (250 mgd of secondary capacity and 750 mgd for primary capacity) for stormwater; a five mile long dual conduit ocean outfall to discharge wet weather effluent 8000 ft offshore from the Lake Merced plant; and a tunnel of up to 32 ft in diameter to move sewage eight miles across town. Problems on the San Francisco side of the Bay involve buying of public lands and receiving sufficient Federal funding.

*Combined sewers, *Storm runoff, *Flooding, *Overflow, Sewers, Treatment facilities, Computers, Effluents, Planning, Costs, Waste water, Tunnels, Flood control

*Rentention basins, Pacific, San Francisco (Calif)

A008
STORM DRAINAGE SYSTEM DESIGN AND NEW CITY PLANNING,

Bonham, A. J.

New South Wales University,
Duntroon, Australia,
Military Studies Department

The Institution of Engineers, Australia, Civil Engineering Transactions, Vol. CE 16, No. 1, p 67-70, 1974. 8 fig, 17 ref.

The design of a major storm drainage system, as part of a new city or as expansion of an existing city, must be based upon strategy integrated with other aspects of city planning. Urban catchments and flood plains in Australia are discussed. A study of the landform and its graded streams in existing conditions as well as the anticipated changes caused by urbanization are both necessary. Data collection should include not only the hydrometric parameters of rainfall, runoff, infiltration, groundwater and water quality but also sediment grading, supply and discharge, historical flood levels, base-flow levels, dominant discharges, effects of vegetation, and already changing land uses. An adequate period of data collection must be provided to study the effects of both floods and droughts. Three channel and flood plain designs are detailed, depending on the urban stream slope and drainage areas. In existing cities, the flood plains are often encroached by urban development so much that pipe culverts and arterial lined channels of restricted width must be designed to convey specific storm drainage discharges. When this available width is small, an arbitrary decision must be made to choose an estimated design frequency. Until new techniques give more precise post-urbanization frequency-discharge relationships, flood plain zone engineering must be based on regional planning to preserve environmental quality.

*Flood plains, Data collection, Model studies, Urban drainage, Design engineering, Environmental effects, Infiltration, Groundwater, Water quality, Sediments

A009
TOTAL URBAN WATER POLLUTION LOADS: THE IMPACT OF STORM WATER,

Vitale, A. M., and Sprey, P. M.

Enviro Control, Incorporated, Washington, D. C.

National Technical Information Service Report No. PB-231 710, 1974. 183 p, 87 tab, 81 fig, 24 ref, 2 append.

This analysis of engineer survey data from eight cities and the effects of storm events on water quality in the Delaware river estuary, estimates the quantities of pollutants entering receiving waters from cities, determines the portions that can be attributed to other than sewage treatment plants, especially storm water related sources, compares the cost and effectiveness of alternative methods of reducing pollution from storm water, and discusses the implication for policy decisions. Major findings of the study included: a large part of the water pollution load created by urban areas results from storm associated surface runoff, storm sewer discharges, sewer overflows, sewer leaks and treatment plant bypasses; pollutant materials include oxygen demanding material, settleable solids, nutrients, heavy metals and other toxic substances, and pathogens and bacteria; urban storm water has been found to have severe impact on dissolved oxygen content in the receiving water; the pattern of storm events is such that the oxygen demand from urban runoff occurs both infrequently and intensely; and the average oxygen depletion due to typical storm events reaches 2 ppm, and the depletion lasts for substantial periods of time--from 8 to 12 days. Policy implications of this study include: both water quality planning and water pollution abatement programs need to be based on an analysis of the total urban pollution loads; municipalities need more federal incentive to identify and perform the comparatively inexpensive and cost effective sewer inspection, cleaning, and maintenance programs which could significantly reduce the discharge of pollutants; and, sewer separation is not a cost effective approach to the storm water problem.

*Storm water, *Storm runoff, *Water pollution sources, Water quality, Cities, Surface runoff, Urban runoff, Storm drains, Combined sewers, Separated sewers

*Delaware River

A010
DRAINAGE SYSTEM COOPERATES WITH NATURE,

Veltman, J.A.

The Woodlands Development Corporation,
Houston, Texas

Public Works, Vol. 106, No. 2, p 86-87, February, 1975. 1 fig.

A natural drainage system is being developed to treat storm water runoff for a planned city called The Woodlands, near Houston, Texas. The existing natural drainage system, Panther Creek, will be used as fully as possible as the trunk line for the system. Where natural drainage is not efficient, due to lack of slope or topography, shallow swales lined with native vegetation will be constructed to handle the water flow. In addition, retention ponds and other flood control devices will be used. Pipes and concrete systems will be used only when urban activity causes storm flow to exceed the system's natural capacities. The proposed plan will result in a city with a population of 150,000 with park-like areas throughout. The system should be effective in dealing with a peak flow of storm water runoff, as compared to a conventional system of curbs, gutters, storm sewers, and concrete ditches. Protection of the water resources will be incorporated into the design, including two main aquifers (recharge capacity of 65 mgd). Penetration of several shallow clay layers will be prohibited, so that vertical groundwater movement will be impeded; residential buildings built over the aquifers will be without basements to avoid puncturing these layers. The system includes the use of existing swales, ponds, low spots, and streams to hold rainfall rather than widespread building of storm sewers. The system will also discharge underground water tables, trap erosion sediment and diminish sudden runoffs which could cause flash flooding and related damage.

*Drainage, *Storm runoff, *Planning, Aquifers, Groundwater, Project planning, City planning, Water resources development, Flood control, Land management

A011
AN ANALYSIS OF RUNOFF IN AN URBAN AREA,

Mori, Y.

Chiba Kogyo Daigaku Kenkyu Hokoku, No. 19, p 133, 1974. 3 fig, 4 ref.

Amounts of effective rainfall entering into a sewage channel in the Tokyo area were calculated and compared with observed values. The sewage channel selected is 4300 km long and its surrounding area is considered to be 6.2 sq km. Market and residential areas are located at the upper stream of the channel; industrial and business areas are located at the lower stream. Types of rainfall are divided into eleven categories based on the rainfall intensity and rainfall period. No clear relationship between effective rainfall and rainfall type was observed. In all cases, the rainfall runoff to the sewage channel was completed within one hour after the precipitation stopped. The effective rainfall increased with an increase in the rainfall intensity. The calculation used basic equations for runoff curve, assuming Mannings law.

*Rainfall, *Sewage treatment, *Municipal water, Runoff, Precipitation (atmospheric), Analytical techniques, Rainfall intensity, Urban runoff

Mannings law

A012
A METHOD FOR PREDICTING FLOOD WATER RUNOFF OF THE RIVER STEYR (LIN VERFAHREN ZUR VORHERSAGE DER HOCHWASSERABFLUESSE DER STEYR),

Kresser, W., and Gutknecht, D.

Oesterreichische Wasserwirtschaft, Vol. 26, No. 11/12, p 249-259, 1974. 11 fig, 3 tab, 7 ref.

A model for the prediction of flood water runoff in the Steyr River, Austria, is presented. The method is based on a precipitation runoff model using precipitation monitoring data. This runoff model consists of: a model for the determination of the runoff formation; another model for the determination of the direct runoffs; and a third model for calculating basic runoffs for the characterization of runoff occurring during the precipitation event. The prediction model gave satisfactory but not optimal results. The runoff formation model is the weakest link of the prediction method. A rapid decrease in the accuracy of the predictions with the extension of the prediction period was found, corresponding to a rapid reaction of the river to intense precipitation.

*Flood forecasting, *Runoff, Models, Monitoring, Data analysis, Precipitation (atmospheric), Flood control, Rivers

River Steyr (Germany), Prediction models

A013
NONLINEAR KINEMATIC WAVE APPROXIMATION FOR WATER ROUTING,

Li, R-M., Simons, D. B., and Stevens, M. A.

Colorado State University,
Fort Collins, Colorado,
Department of Civil Engineering

Water Resources Research, Vol. 11 No. 2, p 245-252, April, 1975. 8 fig, 16 ref.

A simple routing numerical model for rainfall and runoff is presented, which considers both overland and channel water routing. A second-order nonlinear scheme solves the kinematic wave equation numerically, allowing for the boundary condition of time variant inflows. Computations of overland flow include the effects of rainfall on flow resistance and simulate hydrographs; experimental results proved to agree well with these simulations for both constant and variable rainfall. Additionally, the phenomena of pip and dip in overland flow hydrographs were successfully simulated. The applicability of this model was tested with the result that simulated hydrographs agreed well with measured overland flow hydrographs, natural channel hydrographs, and hydrographs from drainage systems.

*Hydrographs, *Simulated rainfall, Runoff, Routing, Rainfall, Numerical analysis, Model studies, Drainage

*Kinematic wave equation, *Overland flow hydrographs

A014
STORM AND COMBINED SEWER ABATEMENT TECHNOLOGY IN THE UNITED STATES--AN OVERVIEW,

Condon, F. J.

Environmental Protection Agency,
Office of Research and Development,
Washington, D. C.,
Municipal Pollution Control Division

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 505-546. 4 fig, 16 tab.

An overview of principal sources of runoff induced pollution as investigated by the Office of Research and Development of the United States Environmental Protection Agency is given. These include: combined sewer (domestic sewage and runoff) overflows, sewered storm water discharges, sanitary sewers surcharged by infiltration, treatment works or pump station bypass, and urban non-point or overland runoff. Remedial solutions for these specific causes must include urban hydrology as well as sanitary engineering. Schematic diagrams of urban hydrologic systems have been developed. In evaluating water pollution loading, strength and mass emission of pollutants from an event must be considered. Projects for control include quantity reduction (infiltration control), quality improvement (deicing methods), runoff rate attenuation (porous pavements), and improved materials (electro-magnetic subsurface profiling) for urban areas. Possible alternatives for effluent management facilities are also detailed. Treatment may be physical, physico-chemical, biological, or biophysical. The well-developed mathematical Storm Water Management Model and associated work are outlined as the prime tools for use in application of a total system concept for selecting water pollution control alternatives.

*Storm runoff, *Urban areas, *Combined sewers, Sewerage, Waste discharge, Treatment, Urban hydrology, Effluents, Water pollution control, Mathematical models

Non-point pollution sources, Storm Water Management Models

A015
AN EVALUATION OF THE EFFECTIVENESS AND APPLICABILITY OF PHYSICAL-CHEMICAL TREATMENT OF URBAN LAND RUNOFF,

Samar, P.

North Carolina State University,
Raleigh, North Carolina

Dissertation Abstracts International B., Vol. 35, No. 10, p 4921, April, 1975.

Urban runoff was treated by a physico-chemical method of coagulation, flocculation, and sedimentation. Sludge handling was also developed, and sludge characteristics were evaluated by density, resistivity, and solid content of the sludge. The selection of an effective coagulant for physico-chemical treatment was investigated by assessing the parameters involved and by evaluating the criteria for efficient treatment. The parameters effective in the design were shown to be directly related to the type of coagulant used. Several organic and inorganic coagulants were evaluated in jar test analyses. The most efficient coagulants in terms of suspended solids removal, COD, and turbidity were found to be alum and the cationic polyelectrolyte Calgon 2660. Based on the parameters of initial suspended solids, alkalinity, and mixing conditions, alum was selected as the best coagulant for treatment of urban runoff.

*Storm runoff, *Sludge, *Coagulation, *Alum, Design criteria, Urban runoff, Suspended solids, Chemical oxygen demand, Turbidity

*Physico-chemical treatment

A016
COUNTY COMBATS URBAN STORM WATER RUNOFF PROBLEMS,

Hoffman, E. K.

Public Works, Vol. 106, No. 5, p 92-93, May, 1975.

Storm water management is being planned in Mecklenburg County, North Carolina, after a study of the effects of urbanization on storm runoff. It was found that an increase in the amount of runoff caused by urbanized impervious areas, coupled with a reduction in lag time, increases peak discharges up to 2 1/2 times, and causes an increased frequency and extent of downstream flooding. To prevent further encroachment on the existing floodplain, a floodway ordinance was passed, restricting development along any stream with a drainage area of at least one square mile. A five-year drainage capital improvement program has also been developed for stream bank sloping and stabilization and for the control of channel widening. In addition, the planning includes erosion and sediment control to minimize stream degradation.

*Water management (applied), *Storm runoff, *Urbanization, Flood control, Flood plains, Streams, Drainage, Storm water

Sediment control

A017
URBAN RUNOFF AND COMBINED SEWER OVERFLOW,

Field, R., and Knowles, D.

Advanced Waste Treatment Research Laboratory,
Edison, New Jersey.

Journal of Water Pollution Control Federation, Vol. 47, No. 6, p 1352-1369, June, 1975. 155 refs.

A literature review of current research on storm water runoff and combined sewer overflow problems is presented. Nonpoint pollution sources are becoming increasingly important. Such urban land runoff pollutants include organic materials with significant amounts of oxygen demand and suspended solids, sediment from urban construction or erosion, unprotected croplands, air pollution fallout, heavy metals such as oil containing lead used for road dust control, highway deicing salts, and chemical fertilizers containing nitrogen and phosphorus. Alternatives for management of storm water pollution were categorized as: source control; collection system control; storage and treatment; and integrated (complex) systems. Runoff predictions using several mathematical methods were discussed. Effective combined waste water pollution abatement alternatives should combine control and treatment facilities. Pollution control may be achieved by computer monitoring and remote activation, by proper maintenance of drainage and sewer systems, by provisions for storage facilities, and, in some cases, by separation of sanitary and storm sewers. The applicability of biological, physico-chemical, and disinfection methods of treatment were compared, as related to overflow. The most promising approaches to urban storm flow management were seen to involve multidisciplinary systems, such as wet-period discharges, dry-period discharges, land use, and water use. Various sampling programs and flow meters are also being developed for analysis of sewer flow and waste water quality conditions.

*Storm runoff, *Reviews, *Combined sewers, *Urban runoff, *Waste water treatment, Pollutant identification, Water management, Monitoring, Computers, Overflow

Nonpoint pollution sources

A018
METEOROLOGICAL, TOPOGRAPHICAL, AND CONSTRUCTION INFLUENCE ON THE RAIN RUNOFF IN SEWER SYSTEMS (METEOROLOGISCHE, TOPOGRAPHISCHE UND BAUTECHNISCHE EINFLUESSE AUF DEN REGENABFLUSS IN KANALISATIONSNETZEN),

Pfeiff, S.

Gesundheits-Ingenieur, Vol. 96, No. 5, p 140-142, May 1975.

Meteorological, topographical, and construction influences on the storm runoff in sewer systems are presented. A critical review was made of existing calculation and design methods. Storm runoff analysis as applied presently is unsuitable for a proposed new coefficient-less method for network filling and runoff calculations. The runoff coefficient is unsuitable, and should be used only for approximate calculations as a ratio of the surface area with full runoff to the total runoff surface. Flow velocity as a parameter should be replaced by throughput in liters/sec and filling should be expressed in liters/min; the term runoff retardation should be abandoned completely. The course of rain over time is of great influence on the storm runoff in the sewer system. A late peak in rain intensity is less favorable for the filling of the sewer system than is an early peak. Analyses of the frequency of network filling in a well-defined water capture area should be used to dimension sewer systems rather than rainfalls yielding a runoff with a definite frequency.

*Sewers, *Rainfall, *Rainfall runoff relationships, *Storm runoff, Design, Meteorology, Reviews

Sewer construction

A019
THE VALUE OF THE PEAK RUNOFF COEFFICIENT PSIS (UEBER DEN AUSSAGEWERT DES SPITZENABFLUSSBEIWERTES PSIS),

Keser, J.

Gas-und Wasserfach-Wasser/Abwasser, Vol. 116, No. 1, p 17-19, 1975. 4 fig, 6 ref.

The value and relevance of using the peak runoff coefficient, a ratio of the peak runoff yield to the peak rain yield, is discussed. The peak runoff coefficient indicates that a certain duration of the peak rainfall yield is necessary to generate an increase in the runoff. The peak runoff coefficient is predominantly influenced by precipitation and topographical characteristics; these describe the distribution of the runoff over time. The dependence of the peak runoff coefficient on the rainfall characteristics is influenced by the terrain but it is not conditioned by the precipitation. The peak runoff coefficient is determined from the transfer function that is characteristic for the terrain, and is constant even for prolonged rainfall events. The total runoff coefficient must be consistently greater than the peak runoff coefficient.

*Rainfall-runoff relationships, *Rainfall intensity, Topography, Runoff coefficient, Precipitation (atmospheric), Mathematical studies, Model studies

A020
EVALUATION AND IMPLEMENTATION OF URBAN DRAINAGE PROJECTS,

Grigg, N. S.

Colorado State University, Fort Collins,
Department of Civil Engineering.

Journal of the Urban Planning and Development Division, ASCE, Vol. 101, No. UP1, p 61-75, May, 1975. 6 fig, 1 tab, 32 ref, 1 append.

The service that urban drainage and flood control systems (UDFC) provide to urban areas has three basic components: flood control; convenience drainage; and, environmental sanitation. Since this service is provided by local governments it must compete for public funding with other more visible programs such as education, transportation, and public safety. This paper details the practical aspects of evaluating an urban drainage and flood control project. The evaluation problem must consider the merit of individual UDFC systems, the ranking of competing UDFC projects, the optimal investment timing, and the incidence of UDFC benefits and costs. UDFC systems are considered to be either minor systems, which provide for the drainage of frequent runoff events, or major systems, which provide for the rarer and more severe events. Financial savings can be realized by cities which use valid and incisive evaluation techniques in the planning, programming and budgeting steps of urban drainage and flood control projects.

*Urban drainage, *Cities, *Flood control, *Project planning, Cost-benefit analysis, Urbanization, Drainage systems, Administration, Decision making, Financing

A021
COMPARISON OF SOME CALCULATION METHODS FOR RAINWATER RUNOFF (VERGLEICH EINIGER BERECHNUNGSMETHODEN VON REGENWASSER-KANALISATIONEN),

Gruhler, J-F., and Adamik, V.

Wasserwirtschaft-Wassertechnik, Vol. 25, No. 7, p 239-242, 1975. 2 fig, 2 tab, 11 ref.

The Imhoff-Reinhold; Hauff-Vikari-Kehr; Gruhler; and Pecher methods; the hydrographic method developed in the United States; and a method developed in the USSR for the calculation of rainwater runoff are compared. These calculation methods involve widely differing calculation time requirements, and considerably different sewer system investment costs. The time coefficient method developed by Imhoff and Reinhold is applicable to the construction of most new projects. The Hauff-Vikari-Kehr method may be necessary in special cases, such as for large new sewer networks. The resources of existing sewer systems that may have to be enlarged are best investigated by the Gruhler method, with respect to their storage capacities.

*Mathematical studies, *Storm runoff, *Rainfall-runoff relationships, Sewerage, Sewers, Storage, Forecasting, Rain water

Calculations

A022
POLLUTION OF RECIPIENTS BY STORM RUNOFF IN MIXED SEWER SYSTEMS: STORM RETENTION BASINS AS A REMEDY (LA POLLUTION DES EMISSAIRES PAR LES DEVERSEMENTS DES RESEAUX UNITAIRES: UN REMEDE LES BASSINS D'ORAGE),

Carre, Y.

Techniques et Sciences Municipales--L'Eau, Vol. 70, No. 7, p 313-317, July, 1975. 7 fig, 6 tab, 14 ref.

A method for the control of the pollution of recipients by storm runoff in combined sewer systems in Baden-Wuerttemberg, Germany, is discussed. The BOD content and the pollutant load were measured. It was determined that the storm runoff, especially that discharged during the initial phase of rain, is often as polluted as the effluents that occur during dry weather. Therefore, retention of the initial runoff in retention basins for subsequent biological in-plant treatment is necessary. Storm runoff retention basins have been designed to retain 90% of the annual BOD5 content in the Baden-Wuerttemberg area.

*Storm runoff, *Sewerage, *Retention, Biological treatment, Waste water treatment, Water pollution sources, Biochemical oxygen demand, Water pollution control, Rain water, Combined sewers

Retention basins, Baden-Wuerttemberg (Germany)

A023
FLOOD WATER ANALYSIS IN THE AREA OF THE TIDAL RIVER EIDER
(HOCHWASSERANALYSE IM RAUM DER BINNENEIDER),

Guevara-Perez, E., and Schendel, U.

Wasserwirtschaft, Vol. 65, No. 7/8, p 190-193, 1975. 1 fig, 4 tab, 14 ref.

The probability of the occurrence of high water flows in the catchment area of the tidal river Eider (Schleswig-Holstein) was investigated by means of different distribution functions on the basis of observation data collected over eleven years. Three distribution functions: log normal distribution according to Galton; log Pearson type III distribution; and gamma distribution were found suitable for the forecasting of flood events. The occurrence of high water flows in the summer period is primarily determined by the precipitation two days and one day before the flood event, as well as on the day of the highest waters. The correlations between high water flow and the various parameters are less certain in the winter period, when high water flow is essentially influenced by the precipitation on the day preceding the event, by the water content of the ground, and by the precipitation on the day of the high water flow.

*Storm water, *Rivers, *Flood forecasting, Floods, Mathematical models, Precipitation (atmospheric), Data collections

Seasonal variations

A024
INFILTRATION--INFLOW ANALYSIS,

Cesareo, D. J., and Field, R.

Journal of the Environmental Engineering Division-ASCE, Vol. 101, No. EE5, p 775-785, October, 1975.

Excessive infiltration/inflow (i/i) from runoff has been defined as the quantities of i/i that can be economically eliminated from a sewer system by rehabilitation. This value is determined by a cost-effectiveness analysis in which the costs of correcting the infiltration/inflow conditions are compared with the costs of increasing the treatment works capacity to provide proper treatment of the i/i quantities. Countermeasures against infiltration and inflow involve either the prevention of excessive extraneous flows or the correction of conditions already imposed on existing sewer systems. A cost-effectiveness evaluation of a surcharged sewer system and overloaded waste water treatment facility should consider at least: increased size and cost of new sewers if i/i is permitted; need for construction of relief or supplmentary collection and interceptor sewers; operation and maintenance costs for handling sewer surcharges, clean up of flooded areas and damages to flooded private properties; costs of repairing pavement cave-ins or washouts of subsurface utilities caused by infiltration and exfiltration; costs of removing soil, debris, and tree roots entering sewers through defective sewer pipes and joints; increased costs at waste water treatment facilities; and future elimination of bypassing untreated flows from sewers. The five phases of a sewer system evaluation survey were outlined as: physical survey; rainfall simulation; preparatory cleaning; internal inspection; and survey report. A hypothetical infiltration/inflow cost evaluation was presented, and costs for an infiltration reduction program in Locust Grove, Oklahoma, and an inflow reduction program at Springfield, Illinois, were detailed.

*Infiltration, *Inflow, *Cost analysis, *Sewers, Rehabilitation, Treatment facilities, Construction costs, Simulation analysis, Waste water treatment, Evaluation

*Infiltration/inflow analysis (i/i)

A025
COLLECTION AND PURIFICATION OF WASTEWATERS (AUFFANGEN UND REINIGEN VON ABWAESSERN),

Kunstoffberater, Vol. 20, No. 8, p 390, August, 1975.

The uncontrolled runoff of chemically contaminated storm water near a chemical plant in southern England made it necessary to build an 11 million liter-capacity collection basin measuring 107 m x 38 m at a maximum depth of 7.5 m. The bottom of the basin was tightly sealed by means of Hypalon, a weather-proof chemical-resistant synthetic rubber soil manufactured by Burke Rubber Company, San Jose, California. The black foil is 0.76 mm thick, and is composed of two Hypalon layers and an interposed nylon layer. The guaranteed service life of the foil is 20 yr. The contaminated storm runoff collected in the basin is pumped over to a treatment unit before being discharged into a river.

*Runoff, *Storm water, *Pollution identification, *California, Chemical industry, Waste treatment, Waste discharge, treatment facilities

*Collection basins

A026
FREEWAY STORM RUNOFF WILL BE CLARIFIED,

Rothstein, M.

Public Works, Vol. 106, No. 11, p 65, November, 1975.

A special outlet extending 2000 feet into Lake St. Clair, Michigan, has been installed to collect surface drainage from an interstate highway. Before entering the underwater discharge line, silt, debris and oil wastes washed from the highway will be prevented from polluting the lake by passing into a 778.5-ft long settling and skimming chamber. Storm water runoff from the highway will be delivered by a 102-inch tunnel sewer to a pumphouse adjacent to the stream end of the chamber. Discharge from the settling and skimming chamber is by a 14-ft diameter drop shaft connected to the tunnel sewer. The chamber, 42 ft long and 12 ft deep, has sluice gates on the discharge end of each side to provide additional flow control. The downstream end of each chamber has a weir to maintain a constant water level. Floating oil retainers and a baffle retain surface oils; these are removed by a floating oil skimmer at a rate of 480 gal/hr. Normally, downstream gates will be closed and flow into the chamber will be at a low rate to allow oils to rise to the surface and become trapped by the baffle. In the event of a major oil spill at low flow, the pumphouse would shut off and oil would be pumped into the sluiceway for removal by pump trucks. If an oil spill occurred during a storm, oil would be trapped in the large chamber of the downstream end and be removed by two skimmer units into a 2000-gallon tank.

*Storm runoff, *Highway effects, *Lakes, Water pollution sources, Oil wastes, Oil spills, Waste treatment, Separation techniques, Pumps

A027
AGRICULTURAL RUNOFF POLLUTES SURFACE WATERS, PART I,

Harms, L. L., Middaugh, P., Dornbush, J. N. and Andersen, J. R.

Water and Sewage Works, Vol. 122, No. 10, p 84-85, October, 1975. 2 tab.

Nonpoint sources of water pollution from urban areas, agricultural lands, forests, and grazing areas have been recognized. In this study, data were presented pertaining to surface runoff from agricultural land. Information was collected on the densities of bacteriological indicator organisms found in the runoff and how these densities related to water quality criteria for the receiving waters. All field conditions were natural and uncontrolled. The most common bacteriological test for water and waste water samples is total coliform. However, because these organisms may result from agricultural matter such as grains or plants, other indicators, fecal coliform (FC) and fecal streptococcus (FS), were used. A FC/FS ratio has been used to determine whether pollution in a water sample is from human or animal sources. Data were collected from seven sites in eastern South Dakota on surface runoff from snowmelt and rainfall. Flow measuring equipment, water level recorders, and automatic samplers were used at each site. Composite samples were made from the discrete samples that had been automatically collected. These were stored at 4 C and tests were performed about 12 hours after initial collection by the sampler. Results of the tests are evaluated in the second part of this article.

*Water pollution sources, *Pollutant identification, *Coliforms, Agricultural runoff, Bacteria, Sampling, Data collection

Fecal coliforms, Fecal streptococci, Nonpoint sources

A028
PERFORMANCE OF PENNSYLVANIA HIGHWAY DRAINAGE INLETS,

Brune, A. W., Graf, W. H., Appel, E., and Yee, P. P.

Lehigh University,
Bethlehem, Pennsylvania,
Department of Civil Engineering.

Journal of the Hydraulics Division-ASCE, Vol. 101, No. HY12, p 1519-1536, December, 1975. 15 fig, 5 tab, 9 ref.

The hydraulic capability and efficiencies of six types of gratings for drainage inlets in Pennsylvania were experimentally tested. These highway drainage inlets were installed either in paved or grassed channels, and the effects of different slopes of the channel, both sides and longitudinal, were investigated. From model tests, it was demonstrated that the efficiency of an inlet grating placed in a channel with fixed side slopes decreases with increasing longitudinal slope. The efficiency of a given grating also increases significantly with increasing swale slope and is maximal if the back slope is equal to the swale slope. It was also found that an inlet installed at the bottom of a vertical curve may be subject to occasional sump conditions; ponding occurred only under extremely high rates of flow. Another test was performed on the efficacy of constructing a dike downstream from an inlet that is installed in a median. Data showed that the capacity of the inlet will increase from two to five times the capacity of the inlet without a dike. The practice of constructing a dike downstream from an inlet would therefore be advantageous, particularly for grades of 0.5% and upward.

*Drainage, *Highways, *Construction, *Hydraulics, Runoff, Storm runoff, Performance

Drainage inlet gratings

A029
RAINFALL-RUNOFF RELATIONS ON URBAN AND RURAL AREAS,

Brater, E. F., and Sherrill, J. D.

Michigan University,
Ann Arbor,
Department of Civil Engineering.

May, 1975. 97 p, 36 fig, 11 tab, 39 ref. PB 242 830.

Estimates of peak discharge and entire flood hydrographs for drainage basins of all sizes and all degrees of urbanization can be made utilizing a newly-developed unit hydrograph-infiltration capacity method. The procedure consists of forming runoff hydrographs of various frequencies by applying the unit hydrograph for that basin size and population density to the precipitation excess. The precipitation excess is precipitation plus snowmelt of a selected frequency minus retention and infiltration on the permeable portions of basins and minus retention on the impermeable portions. The form of the unit hydrograph could be related to drainage basin size and degree of urbanization as measured by population density. As the population increased from rural to highly urbanized, peak discharges for the same runoff became as much as ten times greater. Infiltration capacity was found to vary seasonally. The prediction of flood frequency by this procedure is fully operable for Southeastern Michigar and could apply to other areas if some hydrograph analyses were made.

*Hydrographs, *Floods, *Rainfall-runoff relationships, Population, Storm runoff, Michigan

A030
QUALITY AND VARIATION OF POLLUTANT LOADS IN URBAN STORMWATER RUNOFF,

Droste, R. L., and Hartt, J. P.

Windsor University,
Ontario, Canada,
Department of Civil Engineering.

Canadian Journal of Civil Engineering, Vol. 2, No. 4, p 418-429, December, 1975. 2 fig, 10 tab, 25 ref.

Research into the pollutional loadings of urban storm water was carried out on samples of 13 storms throughout a year in the heavily industrialized town of Windsor, Ontario. Stage levels in the sewers were continuously monitored by a water level recording instrument and hydrographs were made. Samples of discharge were taken and analyzed for such qualities as pH, alkalinity, hardness, BOD, presence of suspended solids, chemical content, and determinaton of grease and oil. Seasonal and annual average concentration values were calculated and recorded in tabular form. It was found that urban stormwater runoff makes a significant contribution to pollution of receiving waters and is not a suitable diluent for sanitary sewage. Runoff delivers a greater pollutant load than effluent from a secondary treatment plant. Significant correlation was found among the following constituents' concentrations: specific conductance and calcium hardness and chlorides; calcium hardness and total hardness; sulfates and total hardness; and total alkalinity and total hardness. Spring, the season with the most rainfall, contributed the highest loads of pollutants except for chlorides and coliforms. Larger amounts of precipitation contributed higher loads to receiving waters. The concentration data given here can be used to plan more efficient treatment of stormwater runoff and to compare the economies and efficiencies of tertiary treatment against treatment of urban runoff.

*Urban runoff, *Storm runoff, *Water pollution, *Hydrographs, *Pollutant identification, Precipitation (atmospheric), Waste water treatment, Tertiary treatment, Sampling, Monitoring

A031
QUURM - A REALISTIC URBAN RUNOFF MODEL,

Watt, W. E., and Kidd, C. H. R.

Queen's University,
Kingston, Ontario, Canada.

Journal of Hydrology, Vol 27, No. 3/4, p 225-235, December, 1975. 3 fig, 2 tab, 10 ref.

In order to develop better techniques for the prediction of urban storm runoff, the Queen's University urban runoff model (QUURM) was developed and tested for application at the existing or planning level. The principal criterion in the selection of the model was its ability to simulate observed flows with a minimum number of flow parameters and reasonable costs for computer and data collecting time. The model consists of two parts. The first part is the total catchment made up of hydrographs taken from four subcatchments. The subcatchments were an impervious front such as a paved street, a pervious front such as a front lawn, a pervious and impervious back such as a back roof and back lawn, and a non-contributing area such as an area lower than the adjacent inlet to the storm-sewer system. The second part of the model combined the hydrographs and routed them through the sewer pipe network to the outlet. The infiltration rate was determined by employing Horton's equation for infiltration capacity. QUURM's simulation results, taken from 10 rainfalls during two summers, were then compared with three other models' results taken from the same rainfalls. QUURM's results compared favorably, and a detailed comparison of QUURM and the EPA model is presented in tables and graphs. The advantages of QUURM are that it is a relatively simple model with a limited number of parameters.

*Hydrographs, *Storm runoff, *Model studies, Urban runoff, Sewers, Rainfall-runoff relationships, Computers, Simulation analysis

Queen's University urban runoff model (QUURM)

B001
ENGINEERING UTILITY AND SEWAGE LINES IN PERMAFROST SOIL,

Yastrebov, A. L.

National Technical Information Service AD 786964, May, 1974. 258 p, 69 fig, 19 tab, 6 append. Translated from Inzhenernyye Kommunikatsii na Vechnomerzlykh Gruntakh, Lit. po Stroitel'stvu Press, Leningrad, 176 p, 1972.

This book presents various methods of laying and designing pipelines for water supply, heat supply, and sewerage, in addition to trunk petroleum and gas lines in permafrost conditions. Chapter one contains general information on engineering utility and sewage lines in permafrost soil. Chapter two covers the construction of sanitary engineering utility and sewage lines and trunk pipelines. Chapter three is a collection of initial data for calculating structures including calculating seasonal thawing and freezing of soils. Chapter four concerns thermal calculations such as heat losses of pipelines, underground conduits, temperature of liquids in pipelines, and amount of insulation. Chapter five outlines the calculation of supports and foundations of engineering utility and sewage lines. Procedures for the thermal calculation of pipelines and for supports and footings of engineering utility and sewage lines in various permafrost soil conditions are set forth. The calculation theory is illustrated with examples from current design practice.

*Sewerage, *Pipelines, *Construction, *Design, Permafrost, Soil mechanics, Soil Properties

Petroleum pipelines, Gas lines

B002
HURRICANE SPURS SEWER RENOVATION,

Water and Wastes Engineering, Vol. 11, No. 10, p 14, October, 1974.

Under the auspices of the Wilkes-Barre Redevelopment Authority, the city of Wilkes-Barre, Pennsylvania is renovating as well as reevaluating its sanitary and storm sewage systems, since the floods from Hurricane Agnes in 1972. Cleaning, closed-circuit television inspection, and repair of existing sewers was done in the South Wilkes-Barre disaster urban renewal project area. As a result of data gathered from the work of Southern Line Cleaning of Casselberry, Florida, a new, updated drainage system for South Wilkes-Barre will be plotted. This is part of an overall $11 million public improvements program to serve the residential area for several decades. The closed-circuit television inspection of existing sewer lines will allow for the inspection of conditions with the highest degree of accuracy possible. These planned programs will result in the first cleaning of existing lines since the flooding of 1972. In cases where crushed lines and non-existent manholes prohibit working on a particular length of line, reconstruction of these collapsed lines and installation of manholes will take place.

*Sewers, *Floods, Drainage, Repairing, Data, Flood damage, Planning, Cleaning, Manholes, Installation

*Wilkes-Barre (Pennsylvania), *Hurricane Agnes, *Closed-circuit television inspection

B003
NEW DIAPHRAGM PUMP UTILIZES OLD PRINCIPLE,

Chemical Processing, Vol. 20, No. 9, p 44, September, 1974. 1 fig.

A new air pressure, diaphragm-operated pump has been designed to handle a wide range of liquids. Its operating principle is the adaptation of the venturi effect to create low pressure and actuate the suction cycle and it may be driven by compressed air, either from mains supply or from a portable compressor. The pump operation is the same as conventional diaphragm pumps but its new feature centers around the control of the cycle or pressurization and evacuation. Air supply and exhaust is controlled by a poppet valve, moved between two end positions by a control rod attached to the diaphragm membrane. The diaphragm is flexible and the pressure of the liquid in the pumping compartment is the same as that in the air compartment throughout the operation of the pump. The applications of this pump range from handling viscous liquids to dealing with various corrosive fluids.

*Pumps, Venturi, Pressure, Valves, Liquids, Operation, Equipment

Diaphragm pumps

B004
PUMPS FOR POLLUTION CONTROL,

Edwards, J. A.

Pollution Engineering, Vol. 6, No. 11, p 26-35, November, 1974. 33 fig.

Design and construction materials for over thirty waste treatment pumps are described. These include the centrifugal pump used for transferring solutions between reaction tanks, the proportioning pump for accurate control of chemical addition, the diaphragm pump for slurries, the screw pump for high viscosity solutions and the gear pump for hydraulic systems. Criteria for choosing the proper pump for a system are detailed. Factors to be considered in selecting a centrifugal pump are total discharge head, net positive suction head, motor RPM, seal design, equipment location, construction materials, solution temperature, and equipment application. A pump may use a packed stuffing box seal or a mechanical seal or may be designed to use no seal at all. Impeller design is usually related to size of housing and type of liquids or solids pumped; impellers described included open and semi-enclosed impellers and shrouded impellers. Sludge handling pumps in pollution control systems are also discussed. Two distinct varieties used are the progressive cavity pump and the diaphragm pump. Pump designs may be single-stage, multi-stage, turbine, diaphragm, in-line or vertical and horizontal centrifugal. Each type fills a specific need, and should be chosen by factors of efficiency and economy.

*Pumps, *Construction materials, *Design criteria, *Centrifugal pumps, Centrifugation, Waste treatment, Sludge treatment, Costs, Waste water treatment, Water pollution control

B005
CORROSION AND ITS COST IN SEWAGE TREATMENT,

Lewin, V. H.

Water Pollution Control, Vol. 73, No. 5, p 548-550, 1974.

A study was conducted by the Institute of Water Pollution Control (Great Britain) for evidence of metal corrosion control in the sewage treatment industry. Goals were to identify major problem areas, to find how local authorities had overcome or attempted to overcome corrosion problems, and to determine the cost of corrosion. Costs were to be broken down into prevention and scheduled maintenance, unscheduled maintenance and repair and applicable research and development services including consulting. Forty-three sewage works responded to questionnaires. The results showed that corrosion is regarded as inevitable and protective measures in the form of paints and coatings vary greatly. Often corrosion is tolerated until it is necessary to replace part or all of the structure; then alternative construction materials may be chosen. Surface treatments should be applied at the time of construction rather than as a later remedial measure for optimal results. However effective the coating, whether it is epoxy resin, paint, chlorinated rubber, or compounds incorporating finely-ground stainless steel, its protection is largely dependent on the thoroughness of surface preparation to clean the bare metal. Costs varied by size, age, and design of the individual sewage treatment plants and no cost generalities could be made from the range of the data.

*Sewage treatment, *Design criteria, *Construction materials, *Corrosion, Corrosion control, Coating, Paints, Maintenance

Metal corrosion

B006
NEWPORT-MAIN DRAINAGE SCHEME TAKES SHAPE,

Millbank, P.

Civil Engineering, p 24-25, 38, December, 1974. 2 fig

The development of a scheme for pollution control on the River Usk at Newport, South Wales is described. The major part of the existing sewerage system carries both sewage water and surface water and was designed over a century ago. In 1960, control of new or altered outlets for the discharge of sewage and trade effluent came within jurisdiction of the river authorities under a Clean Rivers (Estuaries and Tidal Waters) Act. River analysis confirmed that the estuary of the Usk was heavily polluted by decomposing organic matter, that a belt of polluted water swings to and fro with the tide, and that the expected twice daily flushing of the estuary as a result of a large tidal difference of 40 feet does not occur. It was recommended that sewage be discharged into the river below the town of Newport after partial treatment, keeping the dissolved oxygen in the river over 50%, contrasted with the 30% or less that it had been. Work was then begun on a large trunk sewer on each side of the river, to carry up to six times the dwf drawn from existing outfall pipelines. Local relief sewers were proposed to alleviate drainage in problem areas. A final three-stage proposal included stage one as an internal drainage works and a new pumping station, design for a stage two Nash treatment works and a pumping main connect it with the Liswerry pumping station, and a stage three sewage works in the Duffryn area to be connected across the Usk to Nash. A map of the three stages of the project details the scheme as it will be upon completion.

*Rivers, *Water pollution control, *Sewerage, Sewers, Organic matter, Dissolved oxygen, Pipelines, Drainage, Water treatment, Sewage treatment, Waste water treatment

B007
RANDOM PLASTICS MEDIA ARE KEY TO HIGH-QUALITY EFFLUENT,

Rodgers, I.

Process Engineering, p 68-69, August, 1974. 2 ref.

The use of random media for filtering both domestic and industrial effluents has been applied to biological effluent treatment. In the past, stone media were the only type used. Recently however, plastics as percolating filters have been investigated. The major problem, which was overcome, was to devise a shape with the highest surface possible, consistent with the requirements of adequate void space and resistance to compression. The necessary plastic media had to give a surface three times that of stone, or 300 sq m/cu m, in order to be economical. One such product derived from PVC is Flocor RC, developed by ICI. It is tubular in shape with corrugations running around the circumference. The material is inert and is highly resistant to chemical, biological, and photochemical degradation. PVC itself also has strength of compression. New random plastic filters may be used in older systems to replace their stone filters, thus relieving hydraulic and organic overload. They may also be used in new installations. Flocor RC filters have two advantates: they are light in weight--one seventh that of stone media--and thereby give lower cost structures in sheeting materials; and they have negligible power cost, representing another savings.

*Plastics, *Filters, *Effluents, *Biological treatment, Costs, Materials, Filtering systems, Electric power costs

Flocor RC, Random plastic media, Polyvinyl chloride, Stone media (filtering), plastic filters

B008
MANAGEMENT AND CONTROL OF COMBINED SEWER OVERFLOWS--
PROGRAM OVERVIEW,

Field, R.

National Environmental Research Center,
Edison, New Jersey

N.T.I.S. Report No. PB-229 575. 1972. 55 p, 14 fig, 133 ref.

An overview is given of the United States Government involvements in developing countermeasures for combined sewer overflow pollution. Considered are combined sewer overflow problems, including specific pollution parameters measures (such as BOD, TSS, Fecal coliforms, Organic N), and the alternative use of separate sanitary and storm sewer systems. Corrective measures reviewed were: maximization of sewage treatment at the sanitary plant during wet weather; improvement of regulator maintenance; control of infiltration and extraneous inflow; street surface cleaning; and use of polymers to increase flow capacity. Advanced control systems were also discussed, such as flow regulation, storage, porous pavement, and new sewer systems. Types of treatment methods currently under investigation by the Storm and Combined Sewer Pollution Control Program were listed. Full-scale prototype treatment processes are being considered in the areas of: deep-bed, multi-media, ultra high-rate filtration; physical-chemical processes, including the concepts of in-line or in-pipe coagulant mixing and activated carbon adsorption with on-site regeneration of coagulants and carbon; vortex treatment systems; and helical or spiral flow regulation/solids separation.

*Combined sewers, Pollution control, Sewage treatment, Sewerage, Storm sewers, Waste treatment

Sewer overflow, Sanitary sewers

B009
DAVENTRY SEWERAGE SCHEME COMPLETED AHEAD OF SCHEDULE,

Water Services, Vol. 78, No. 941, p 252, July, 1974.

Construction of a new sewage disposal works at Daventry, Great Britain, has been designed to treat both industrial and domestic effluents. The works is capable of handling a population of 30,000, which is the estimate for 1980. In addition, engineers have designed the works for 100 percent extention of capacity, with available land for even further expansion. Over eight miles of cast iron pipes of up to 30 inches in diameter have been laid to connect sewerage purification equipment within the plant. In addition, a sludge treatment area, administration buildings, a sludge press house, two pumping stations, a land treatment area, pipework chambers, and access and site roads have been constructed. In order not to disrupt motor or rail traffic, excavation was done by a thrust boring technique. The greatest problem faced was underground water found in the tunnel section. Continuous deep well pumping was necessary at three bore holes, during construction and removed 250,000 gallons per 24 hours. The new treatment works are under the auspices of the Northampton Sewage Division of the Anglian Water Authority. When these are opened, they will replace the old Daventry sewage treatment works for joint municipal/industrial treatment.

*Construction, *Sewage treatment, Municipal wastes, Industrial wastes, Underground streams, Treatment facilities, Tunnels, Waste treatment, Waste disposal

Great Britain, Combined municipal-industrial wastes

B010
THE DEVELOPMENT OF A SCHEME TO CONSTRUCT LARGE DIAMETER SEWAGE PUMPING MAINS ACROSS THE RIVER TEES AND THE TEES RAILWAY MARSHALLING YARD,

Firth, F. M.

Chartered Municipal Engineer, Vol. 102, No. 4, p 72-76, April, 1975. 5 fig.

Construction of a two stage sewerage scheme has begun on the River Tees, Great Britain, one of the country's most polluted estuaries. The first stage, to be completed by 1976, is a system of interceptor sewers, gathering flows to a point on the river where there already is a concentration of major sewer outfalls and where available land exists for a new sewage treatment works. The system will service a population of up to 170,000 with a maximum design flow of 3200 liters/sec. A large amount of variation in flow quantity to be pumped is accommodated by two pipelines of 1.0 m bore and one pipeline of 0.7 m bore. Design velocity within the mains is about 2.0 m/sec with a maximum pumping head of 21 m. Design criteria included possible routes of the pipeline with cost optimization, choice of pipeline material, and analysis of surge pressure.

*Sewage, *Waste water treatment, *Pipelines, Design criteria, Construction materials, Interceptor sewers, Water pollution control, Sewage treatment, Rivers

River Tees (Great Britain), Surge pressure analysis

B011
PRINCIPLES OF ESTABLISHING SEWER SYSTEMS IN THE RURAL SETTLEMENTS OF MAGDEBURG COUNTY (GRUNDLAGEN FUER DIE ABWASSER-TECHNISCHE ERSCHLIESSUNG VON LANDGEMEINDEN IM BEZIRK MAGDEBURG),

Boelsch, G., Baersch, L., Winter, H., and Petzold, S.

Wasserwirtschaft-Wassertechnik, Vol. 24, No. 6, p 199-201, 1974. 1 tab.

The principles of establishing sewer systems in the rural settlements of Magdeburg county, East Germany, are presented. The rural sewer systems will be designed to minimize costs and with the possibility of extensive volunteer work. The sewer systems will incorporate pipes 200 or 300 mm in diameter for gravity flow. There will be no discharge possibility from cellars and basements. An improved mixed sewer system with rainwater retention and rainwater purification basins will be adopted. These basins will be designed for a hold time of 10-20 min. Mechanically purified rainwater will be discharged into the recipients for a few hours each year.

*Sewerage, *Rural areas, Percolation, Pipes, Rainfall-runoff relationships, Rain water

Magdeburg (Germany), Retention basins, Gravity flow

B012
SUBMERSIBLE PUMPS MAKE BY-PASS POSSIBLE,

Redner, J. A., and Kenmir, J. E.

County Sanitation Districts,
Los Angeles, California

Water and Wastes Engineering, Vol. 12, No. 4, p 62, 64, April, 1975.

Five submersible pumps in Los Angeles County, California, have been installed to provide emergency by-pass of waste water pumping stations. This installation was in response to a flooding in 1972 when power was lost and waste water from a wet well flooded the pump house. Portable submersible pumps were chosen because of operating reliability. Of the pumping stations in the Los Angeles district, 23 have volume and head conditions in the correct range for high-capacity electric submersible pumps. Of these stations, conditions range from 9000 gpm at 26 feet to 1200 gpm at 150 feet. Extreme emergency conditions would require two pumps in parallel to handle the flow. The pumps ordered consist of two 30 hp Flygt Model CS 3200, two 77 hp High Volume Flygt Model CS 3300, and one 88 hp High Head Flygt Model CS 3300. In an emergency, a pump will be rushed by truck to the disabled pump station. A quick coupling discharge pipe can be connected to a flanged fitting on the pump and the pump and discharge pipe will be lowered into a pumping manhole along guide rails. The free end of the aluminum discharge pipe will then be connected to a permanently installed force main connection pipe using a victaulic coupling. The entire connection operation should average only thirty minutes before actual by-pass pumping begins.

*Pumps, Valves, Pipes, Flood control, Equipment, Installation, Sewerage, Waste water treatment

Los Angeles (Calif.), Submersible pumps, Pumping stations

B013
WASTEWATER LIFT STATION OPENS WAY TO URBAN EXPANSION,

The American City, Vol. 90, No. 3, p 59-60, March, 1975.

A pre-engineered underground pump station was built and installed in Homewood, Illinois in order to control the sewerage system of an expanding residential development. This lift station is capable of transferring up to 8.3 mgd of sewage collected from the annexed area to the Homewood receiving line. The station has three pumps, with two of these already put into operation. Sewage will flow into a 4000 gallon wet well; as this well fills, back pressure on a compressor-operated air bubbler increases until a mercury pressure switch is actuated. At a pre-determined level, the switch energizes one of the two pumps. The mercury pressure of each pump is set so that both pumps may operate during periods of maximum flow, distributing their work evenly. The pumps then discharge the sewage through a check valve and a discharge gate valve to a force main; the sewage then flows by gravity for another one and one quarter miles to the treatment plant. Each pump is rated at 4200 gpm against a total dynamic head of 38 feet and is driven by 60 hp, 875 rpm electric motors. Only a six-week installation period was required for the entire station, which arrived pre-constructed from Ecodyne in Kansas. Thus far, maintenance has been minimal, and records of meter readings are kept daily.

*Pumps, Sewerage, Installation, Sewage treatment, Maintenance, Equipment

Pump stations

B014
METER FOR SEWER FLOW MEASUREMENT,

Wenzel, H. G., Jr.

Illinois University, Urbana,
Department of Civil Engineering

Journal of the Hydraulics Division, ASCE, Vol. 101, No. HY1, p 115-133, January, 1975. 11 fig, 3 tab, 17 ref.

In order to facilitate urban in-system sewer flow measurement, various flow meters have been tested. The characteristics necessary for an ideal sewer flow meter include: capability of operation under both open channel and full flow conditions; known accuracy throughout the range of measurement; minimum disturbance to the flow or reduction in pipe capacity; minimum of field maintenance; compatibility with real-time remote data transmission; and reasonable costs of construction and installation. Such a flow meter was designed using a simple Venturi principle; its features are described. Laboratory tests indicated that the Venturi type meter was capable of measuring sewer flows under both open channel and full flow conditions. Two pressure sensors are required, and the process is simple and low in cost. The disadvantages of this meter are that the capacity of the pipe is reduced due to added energy loss caused by the constriction, and that the chances of clogging are therefore increased. It was also found that differences in performance between the symmetrical and asymmetrical constrictions were not great. The throat length should be at least 2.25 D, but should not be any larger than 4.00 D; exit and entrance transmissions should be on a 1:4 slope. No sediment tests have yet been performed in the laboratory to evaluate potential clogging characteristics. Field testing is also necessary before this sewer flow meter may be applied to urban in-system flow data as correlated with rainfall and quality data.

*Waste water treatment, *Sewers, *Flow measurement, *Venturi meters, *Water quality data, *Measurement, Instrumentation, Data transmission, Rainfall, Laboratory investigations, Sewerage, Design criteria, Construction

B015
LARGE DIAMETER SUBMARINE STEEL PIPELINE CROSSINGS,

Mackay, D.

Greater Vancouver Regional District,
Vancouver, British Columbia, Canada

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, Vancouver, British Columbia, p 71-92. 24 fig.

The Greater Vancouver area of British Columbia presents many engineering problems for the bulk transportation of water and sewage. To solve these problems, numerous submarine pipeline crossings have been installed at various sewage and water districts. To minimize the cost of the river crossings, new methods for assembling the units on land and pulling them into position in a dredged trench were devised. Innovative techniques have been developed for the installation of pipelines in large, fast moving alluvial rivers. The main features of the design and construction of six steel pipe submarine crossings are discussed. Some of the unique design features and new construction techniques for the installation of these large diameter steel submarine conduits include: a circular profile system which places no limit on the size and weight of conduit that can be installed as long as the circular profile can be achieved by open cut; the flectural bending of large diameter steel pipes to a degree of curvature greater than that previously used; and the launching of large diameter multiple steel pipes in a single package from timber skids on shore. The circular profile system is particularly useful where the launching space is restricted and the diameter of the pipe precludes the use of flectural bending. In the crossings described, the radii of curvature for 48, 54, and 66 inch pipe have been limited to 2400, 3000, and 4000 feet, respectively.

*Pipelines, *Pipes, Sewerage, Water conveyance, Distribution systems, Steel pipes

*Submarine pipeline crossings

B016
AN EQUITABLE SEWER USE CHARGE SYSTEM,

Podolick, P. A.

Gilbert Associates, Incorporated,
Reading, Pennsylvania

Public Works, Vol. 106, No. 5, p 91, 95, 136A, May, 1975. 1 tab.

As a result of the Federal Water Pollution Control Act Amendments of 1972, equitable sewer use charge systems are being developed and implemented. Traditional sewer rentals or charges were based on an "economy of scale", whereby the more cubic feet of waste water a particular user discharged, the less per cubic foot he would pay. The PL 92-500 guidelines stipulate that all recipients of Federal funds must pay a base charge in proportion to their contribution to the total waste water loading of their treatment works. In addition to the base charge, an industrial waste surcharge will be applied to all users who discharge waste water with concentrations of BOD, suspended solids, and/or dissolved solids in excess of those of normal domestic sewage. The base user charge assumes that domestic users discharge waste water with similar characteristics, and is determined by computing the total operational and maintenance costs for the previous year and dividing this figure by the total volume of waste water treated that year, to yield a charge in dollars per cubic foot of waste water discharged. For non-domestic wastes, an industrial surcharge is based on the preliminary determination of actual cost of treatment on a unit cost basis for BOD, suspended solids, and dissolved solids. A formula for quarterly surcharge is then implemented, involving unit treatment costs and waste loadings for each parameter as applied to an individual system. The formula must be updated each year by determination of current unit treatment costs.

*Federal Water Pollution Control Act, Costs, Sewers, Treatment facilities, Waste disposal, Biochemical oxygen demand, Suspended solids

B017
ENVIRONMENTAL CONSTRAINTS CHALLENGE DESIGNERS OF SHORELINE COMMUNITY NEAR KANSAS CITY, MISSOURI,

Gray, G. C.

Larkin and Associates, Consulting Engineers, Kansas City, Missouri.

Professional Engineer, Vol. 45, No. 6, p 42-44, June, 1975.

Waste disposal in a planned community near Kansas City, Missouri, had been accomplished by septic tanks, with absorption field effluents being pipelined to a recreational lake. In 1917, planners decided to develop an alternate disposal method which would protect the Lake Weatherby quality, involving a sanitary sewer system. When a gravity sewer system with ultimate treatment at the Kansas City treatment facility was considered, project costs were found to be too high. A vacuum type sewer system would not be effective in waste treatment for this particular topographic condition. A pressure sewer system was then chosen, featuring small size pressure main lines constructed along the street rights-of-way, following the street profile at a shallow uniform trench depth, with a pump unit at each home, pumping into the main pressure line. The pump units consist of an integral grinder and are installed in an opening about four feet in diameter and five feet deep. The final design was a cost effective pressure sewer system constructed of SRD-26 (160 psi rated) PVC pressure pipe. The project included 309 grinder pump units, 35,000 linear feet of main pressure sewers, 37,100 linear feet of pressure service lines from pumps to street mains, 42 air relief valves, 24 flushing and cleanout connections, and 5300 linear feet of eight-inch gravity sewer for connection to existing Kansas City interceptor sewers.

*Waste disposal, *Sewage disposal, *Pumps, Planning, Recreation facilities, Waste water treatment

*Pressure sewers, *Gravity sewers, Kansas City (Mo.)

B018
SUFFICIENT WATER SUPPLY AND SEWER SYSTEM, AND EQUITABLE DISTRIBUTION OF THE COSTS (TILLSTREKKELIGE VANN- OG KOLAKKANLEGG-SAMT RETTFERDIG FORDELING AV KOSTNADENE),

Smits, C.

Teknisk Ukeblad-Teknikk, Vol. 122, No. 15, p 41-42, April, 1975. 6 refs.

The new Water and Wastewater Fee Act, promulgated on January 1, 1975 in Norway, is described. A uniform fee system was designed to provide for a sufficient and dependable water supply, and to set the water and sewage fees to cover their respective costs, as well as to promote economization. Payment shall be for the actual, metered consumption. The sewage fee to be paid will be determined on the basis of water consumption, assuming that the volume of the water consumed is equivalent to that of the waste water discharged into the sewer system. Special discounts will be available for users with installations providing water economy, as compared to conventional systems, and for those users who discharge waste water with very low pollution levels.

*Sewers, *Waste disposal, *Costs, Water pollution control, Water supply

*Sewer use charges, Norway, Waste water discharge

B019
VACUUM SYSTEM FOR SEWAGE DISCHARGE IN KREMPEL (DISTRICT OF DITHMARSCHEN)- EXPERIENCE WITH A NEW KIND OF SEWERAGE (VAKUUMENTWAESSERUNG KREMPEL/DITHMARSCHEN- ERFAHRUNGSBERICHT UEBER EINE NEUARTIGE KANALISATION),

Drebes, H., and Ivers, H.

Wasser und Boden, Vol. 27, No. 5, p 115-118, May, 1975. 4 fig, 2 tab, 2 ref.

The new vacuum sewer system in Krempel, a village of 500 inhabitants in the district of Dithmarschen, West Germany, is described. Due to the lack of sufficient slopes, a vacuum system including waste water pumps, two vacuum pumps, collection tanks, and PVC pipes cost about 50% of a conventional gravitational system. Storm runoff is not provided for, and the storage capacity of the vacuum sewer system is limited. Emergency overflow is not possible. The valve-controlled connection shafts are 80 cm in diameter and 150 cm in height. All repair and maintenance work must be done by trained personnel to avoid damages and breakdown.

*Sewers, Waste disposal, Pumps, Storm runoff, Overflow, Personnel, Construction materials

*Vacuum sewers, Waste discharge

B020
IMPROVEMENT OF COMBINED SEWER SYSTEM ADDING STORM WATER STORAGE POOL (Goryu-shiki gesuido no kairyo, taisui ike hoshiki),

Matsubara, S.

Gesuido Kyokaishi, Vol. 12, No. 131, p 39-46, April, 1975. 9 fig, 5 tab, 6 ref.

Combined sewer systems, in which excess water from rainfall is forced to flow to a municipal river, may be improved. This simulation considers a hypothetical storage pool to reduce the discharge of sewer water into a river under rainfall conditions. Two cases were discussed, each considering the amount of rainfall, capacity of the sewer system, input rate of the sewage water by an urban population, BOD value in the sewer system, storage pool capacity, and capacity of the pump which is used to flush back the water in the storage pool to the sewer system when rainfall has stopped. A calculation was made for the Atsugi drainage system in which excess sewer water is flowed to a nearby river when the input rate of sewer water exceeds 3.0 cu m/sec. When a 30,000 cu m storage pool was employed with a pump of 2.3 cu m/sec capacity, the calculated number of overflows of the sewer system was 4.2/year which is 15% of the present number; overflow water into the river was 5.9 ton/year or 33% of the present level, and the overflow time was 102 hr/year or 16% of its present level. If the capacity of the storage pool was 10,000 cu m with the 2.3 cu m/sec pump, the overflow is calculated to occur 10.3 times/year with an overflow amount of 11.3 ton/year and overflow time of 29.8 hr/year. As long as the pump capacity is kept at over 0.5 cu m/sec, the determining factor of sewer water overflow to the river is the capacity of the storage pool.

*Combined sewers, *Rainfall, *Storm water, Waste water treatment, Sewerage, Model studies, Rivers, Overflow

Storage pools, Japan

B021
PIPE INSERTION RENEWS SEWERS WITH LITTLE EXCAVATION,

Water and Sewage Works, Vol. 122, No. 6, p 56-57, June, 1975. 2 fig.

The collapse of a major clay outfall line which led directly to the Wylie, Texas sewage treatment plant occurred in 1972. The black-clay soil in that area is extremely corrosive; also, soil expansion during wet seasons exerts crushing pressures on the system's clay sewer pipes. The cost of direct burial of ductile iron pipe as replacement was the prohibitive amount of $175,000, and the city of Wylie chose instead to insert a flexible, corrosion resistant polyethylene pipe into 3730 feet of their deteriorated sewer lines. This new method saved the city close to 80 percent of the cost of the burial method. "Aldyl" D polyethylene pipe, 13 3/8-inch diameter was heat-fused so that continuous lengths of up to 600 feet were formed. Ten lengths of plastic piping were each pulled by a 5/8 inch steel cable, threaded through the sewer from a winch located at a pulling excavation to an access trench at the opposite end of the line. Sewer insertion renewal was completed without disruption of service to the community, and excavation time was greatly reduced as compared to conventional pipe replacement.

*Waste water treatment, *Sewerage, *Sewage treatment, *Piping systems, Pipes, Plastic pipes, Costs, Construction materials, Pipelines, Sewers, Texas, Outfall sewers

Sewer repair

B022
MILE OF SEWER LINE RENEWED WITH PLASTIC PIPE,

Roads and Streets, Vol. 118, No. 6, p 94, 96, June, 1975. 3 fig.

Problems of backups, seepage, and an overloaded system due to breakdowns of existing pipes from unstable soil conditions in Houston, Texas have been solved. Rather than a conventional system of pipe removal and replacement, a one-mile sewer line was lined with ultra high molecular weight high density polyethylene pipe. This type of plastic piping is strong, very flexible, completely watertight, and chemically inert. Seven excavations were made over an 80 work day period and no more than one block of streets was closed to residents at any time. Segments of 8-inch diameter pipe 120, 350, and 453 feet long were inserted into the deteriorating line. A 16-inch diameter line was pulled 1016 feet, and a 20-inch diameter line was pulled 2350 feet. A remote tapping technique was used to connect house laterals to the sewer mains. This was the first municipal application of the tapping system. It involved: swaging down the flared plastic pipe (used for the connection) at the work site by forcing it into a die, making its diameter smaller; inserting the swaged pipe into a hole in the sewer main to the depth of the shoulder of the swage; and allowing the swaged part of the polyethylene pipe to return to its original size for a pressure tight seal.

*Waste water treatment, *Sewerage, *Plastic pipes, Construction materials, Pipes, Piping systems, Costs, Sewage treatment, Texas

Remote tapping, Sewer repair

B023
OPEN CUT METHOD USED FOR MAJOR SEWER,

Engineering and Contract Record, Vol. 88, No. 6, p 14-15, June, 1975. 2 fig.

Open cut methods are being used by the Beaver Underground Structures of Ottawa, Canada, to install 2500 feet of a 5742 foot sanitary collector sewer. As compared to conventional tunneling, costs of the open cut method will be considerably lower. This method is possible with the use of large trenching equipment and sophisticated dewatering techniques. One of the first Koehring 1266D hydraulic excavators, with a maximum reach at grade level of over 60 feet and a maximum dig depth of 40 feet, was used for excavation; its five sized buckets have a capacity range from 5 1/2 to 12 5/8 cubic yards. Additionally, the project utilizes the Fiat-Allis HD41, the largest existing bulldozer, which can push up to 28 cubic yards of material at one pass. Pipelaying, pipe alignment by laser, and backfill are described. A deep well dewatering system was chosen, comprising 13 permanent wells. A pump system operates which pumped 7 mgd at its peak. A 10-ft diameter tunnel has been excavated using two sunken shafts, one supported with steel sheet piping and ring beam whalers, the other with a 3-gauge liner plate. When completed in late 1975, the tunnel will be concrete lined to a 7 foot 6 inch diameter using full circle steel forms.

*Sewers, *Waste water treatment, Tunneling, Construction equipment, Earth handling equipment, Pipelines

Sanitary collector sewer, Open cut construction method

B024
SEWER SYSTEM EVALUATION AND REHABILITATION COST ESTIMATES,

Farmer, H.

Water and Sewage Works, Reference number, p 8-9, April 30, 1975.

A method is outlined for developing sewer system evaluation and rehabilitation cost estimates for infiltration/inflow analyses. This cost estimation method is based on calculating rehabilitation costs for eliminating both excessive infiltration and inflow in a sewer system. Rehabilitation costs for infiltration were determined to equal the sum of costs for each infiltration source and each manhole reach to be grouted. A total inflow rehabilitation cost can be computed by adding the costs for individual inflow sources (such as from leakage or holes in manhole covers, foundation drains, catch basins, ditch or storm sewers, or area drains). A complete sewer system evaluation survey consists of five phases: physical survey, rainfall simulation, preparatory cleaning, internal inspection, and survey report. An estimated cost of the complete survey is $0.65 to $0.95 per foot for the total length of the sewer system. A cost-effective evaluative survey is one where results of the physical survey and rainfall simulation are used to determine the actual sewer segments which require cleaning and internal inspection. It is recommended that actual costs of the evaluation be established by a cost plus a fixed fee, a fixed price, per diem, salary multiplier, or by a closed end contract.

*Sewers, *Construction costs, Cost allocation, Infiltration, Inflow

Sewer inspection, Sewer rehabilitation

B025
PROVIDING SUBURBAN SEWERAGE DESPITE ENVIRONMENTAL AND CONSTRUCTION PROBLEMS,

Asmus, D., and Orr, J.

Public Works, Vol. 106, No. 7, p 76-77, July, 1975. 3 fig.

An internal trunk sanitary sewerage collection system was planned and constructed by the suburban community of Minnetonka, Minnesota. The system has been designed for a population equivalent of 160,000; projected costs were 15 million dollars with financing largely through the sale of general obligation improvement bonds. Construction was carried out by a series of thirty-one separate trunk sewer contracts. One environmental problem in construction was the building of an 18-inch gravity sewer out across Wing Lake in order to avoid damaging trees in the adjacent wooded land. To facilitate construction, over 17,000,000 gallons of water were pumped from the lake and it was afterward refilled from the municipal water system. Other problems included placing of sewers on treated wood piling in unstable soils such as the glacial moraine marsh areas, and the frequent drying up of private wells due to construction dewatering. The first problem was solved by longitudinal pile spacing of eight to twelve feet; the second was solved when residents with dried-up wells were supplied with a temporary water source and wells were found in most cases to be usable after dewatering operations were stopped.

*Sewerage, *Construction costs, *Construction equipment, Environmental effects, Dewatering, Waste water treatment, Sewage treatment

Sanitary sewers, Gravity sewers

B026
INFILTRATION INFLOW PROGRAM FOR EPA GRANTS,

Beckwith, R. A.

Water and Sewage Works, Reference Number, p 16-18, April 30, 1975. 2 fig.

Federal legislation requires that municipalities applying for new grant funds for interceptors and sewage treatment plants prove that their existing sanitary sewer systems are not subject to excessive infiltration/inflow (i/i). Infiltration is primarily leakage from the groundwater table and occurs into cracked pipe, deteriorated lateral connections, or offset joints. Inflow is mainly the water entering a sanitary sewer system from rainfall runoff. Inflow sources are relatively easy to locate and correct, and include manhole covers, roof leaders, area-way drains, basement drains, and connections between storm and sanitary sewers. An i/i program consists of analysis and evaluation. The analysis portion is an overall study of various subsystems, accomplished by studying records of the sewage plant, water plant, and rainfall of an area, and by making selected flow measurements at predetermined key manholes. A choice is then made between continued treatment and evaluation for possible rehabilitation, depending upon which is more economical. Following analysis, evaluation may be performed on recommended areas and consists of a physical survey, rainfall simulation, preparatory cleaning, television inspection, and a cost effective analysis. By locating exact defects and estimating the amount of leakage, it can best be determined whether it is more costly to rehabilitate the defect or to continue treatment of the infiltration/inflow.

*Infiltration, *Inflow, *Legislation, *Sewerage, *Sewage treatment, Treatment facilities, Rainfall-runoff relationships, Sewers, Federal Water Pollution Control Act, Groundwater, Simulation analysis, Waste water treatment

Sewer repair, Infiltration inflow programs

B027
THE SELECTION AND APPLICATION OF SLURRY PUMPS,

Arnold, E. L.

Pumps and Their Applications, The International Technical Review, No. 105, p 763-967, June, 1975. 10 fig.

Basic facts concerning when to specify a slurry rated pump, which type of pump to use, and proper application of such pumps are reviewed. The centrifugal slurry pump may be used for municipal sewage, industrial wastes, and evaporator-crystalizer fluids, and should be considered when the fluid to be pumped contains more solids than are found in potable water. Choice of pump should be initially based on the liquids to be pumped in terms of physical and chemical characteristics. Other influences on the choice of pump include required heads and capacities, plant layout considerations, and economic requirements. Basic pump material is usually cast iron, sometimes reinforced with 3% nickel for corrosion protection. Also, materials such as rubber linings may be used for pump protection. The main working basis for pump selection is the System Curve. This is illustrated by several graphs and represents a plot of the head which must be met by the pump at any given series of capacity points, as determined by the piping. Thus, once the static nature of the slurry is known, and the plant requirements and manufacturer's specifications are stated, one can choose a slurry pump that meets design requirements and has performance curves, which when laid on the System Curve form an intersection at a point low enough to minimize wear.

*Slurries, *Centrifugation, *Pumps, *Design criteria, Hydraulic engineering, Liquids, Construction materials, Waste water treatment

Slurry pumps

B028
PLANNING AND CONSTRUCTION OF SEWER AND DRAINAGE SYSTEMS (PLANUNG UND BAU VON KANALISATIONS--UND ENTWAESSERUNGSANLAGEN),

Kiefer, W.

Technische Mitteilungen, Vol. 68, No. 5, p 159-164, May, 1975. 5 fig, 13 ref.

General principles and problems of the planning and construction of sewer and drainage systems are presented. Runoff as a basis for the dimensioning of sewer systems may be calculated from empirical values as a function of both the number of inhabitants and of the water infiltration, which is a function of the age of the sewer system. Storm runoff is usually calculated on the basis of Reinhold's rain yield curves. The critical rain yield is taken to be 15 liters/sec, which implies that a much larger quantity of water is to be fed into the waste water treatment plant, and that the facility would require the use of additional storm overflow and storm retention basins.

*Storm runoff, *Waste water treatment, Overflow, Rainfall, Planning, Sewerage, Sewers, Drainage systems, Treatment facilities, Storm water, Mathematical studies

Storm retention basins, Rain yield, Reinhold's curves

B029
PLASTIC OUTFALL LAID EXTRA DEEP,

Water and Pollution Control, Vol. 113, No. 7, p 19, 25, July, 1975.

A 1670-foot, 24-inch diameter municipal outfall of polyethylene pipe was installed to replace a deteriorated line at Powell River, British Columbia. Because the line discharges its wastes 200 feet below the surface, stresses that would be imposed on the large-diameter pipe had to be evaluated before construction. This was accomplished with a computer program called Stress Evaluation for Submergence in Marine Environments (SESME). It was found that excessive bending stresses could be eliminated by attaching cedar logs to the floating pipe; the logs were later salvaged once the pipe had been located on the ocean bottom. A polyethylene material was chosen for the outfall line in order to achieve maximum flexibility, particularly where the route followed the curvature of the terrain. Specifications for the line included: tolerances for minimum radius of curvature for the 15-degree bend in the line; maximum departure from design alignments; and requirements for ballast weights to provide negative buoyancy for the pipeline. The line was joined on shore, and then was laid on the sea bottom using a "controlled sink" method, whereby water was allowed to enter the shore end of the pipe while displaced air was expelled from the other end. The pipe formed an S-type curve off the bottom to the surface, and held its shape as it sank toward the outboard end. When the outfall was in place on the ocean bottom, a mini-submarine was used for final inspection of the installation.

*Plastic pipes, *Outfall sewers, Canada, Waste disposal, Construction materials, Pipelines, Computers, Inspection, Installation

Marine disposal, Stress Evaluation for Submergence in Marine Environments (SESME)

B030
PUMPING APPLICATIONS. . .SEWAGE, SLUDGE, AND SLURRY,

Leaney, G. M.

Pumps and Their Applications, No. 105, p 770-773, June, 1975. 5 fig.

Types of pumps which may be used for controlling the flow of sewage are described and compared. Mechanical pumps are of two general categories--positive displacement and rotodynamic. Positive displacement action is one of compressing the medium; rotodynamic action is one of throwing. Two types of positive displacement pump designs are rotary and reciprocating. In rotary type pumps, all working parts rotate in one continuous direction so that discharge is uniform and regular. These are not suitable for handling large solids or abrasive materials. In reciprocating pumps, the general operating principle is that of a plunger driven back and forth, allowing the liquid into the cylinder, and emitting it at the opposite end of the stroke. Output from reciprocating pumps is pulsating and connecting pipelines are subject to pressure fluctuations. The other category of pumps, rotodynamic ones, have become widely used in sewage handling since the development of the open impeller type, a derivative of the centrifugal pump. Such pumps can cope with greater throughputs than can the positive displacement pumps. A uniform condition results from their use in that a definite head develops from the centrifugal pump, dependent upon the diameter of the impeller and the speed. Vertical type centrifugal pumps are positioned at the bottom of a pit; integral horizontal pumping units may be applied for pumping and tankage. While positive displacement pumps are more efficient than the rotodynamic pumps, the latter type generally have lower maintenance costs and are less prone to wear in the handling of abrasive materials.

*Pumps, *Sewage treatment, *Centrifugal pumps, Impellers, Design criteria, Flow characteristics, Pumping, Maintenance costs, Waste water treatment

Positive displacement pumps, Rotodynamic pumps

B031
HOW TO ANALYZE INFILTRATION/INFLOW,

Cesaro, D. J., and Field, R.

National Environmental Research Center,
Cincinnati, Ohio,
Environmental Protection Agency.

Water and Sewage Works, Reference Number, p 84-88, April 30, 1975. 2 tab. 11 ref.

A review of the analysis of infiltration/inflow (i/i) is presented. A thorough evaluation should consider factors of cost-effectiveness, including: the cost and size of new sewers if excessive i/i is to be permitted; the operating and maintenance costs for handling local sewer surcharges, clean-up of flooding, and damages to flooded private properties; costs of repair of pavement cave-ins or washouts of subsurface utilities caused by i/i; costs of removal of soil, debris, and tree roots which enter sewers through defective sewer joints and pipes; and need for increases in treatment or handling capacities because systems are overloaded with excessive infiltration and inflow volumes. The required sewer system evaluation survey, consisting of five phases (physical survey, rainfall simulation, preparatory cleaning, internal inspection, and survey report) is outlined. Guidelines for cost analyses of infiltration and inflow are also given. Examples of an infiltration reduction program in Oklahoma and an inflow reduction program in Illinois illustrate some of the problems encountered. Although a cost-effective solution is strongly recommended, it was concluded that one should always consider the overall impact of any changes on overall water quality.

*Infiltration, *Inflow, *Reviews, *Analytical techniques, Sewerage, Construction, Rehabilitation, Rainfall, Inspection, Water quality, Operating costs, Maintenance costs, Flooding, Waste water treatment

Cost-effectiveness, Infiltration/inflow analysis, Sewer repair, Sewer system evaluation

B032
HOW MANY WASTEWATER TREATMENT PLANTS ARE NECESSARY IN REGIONAL SEWER SYSTEMS (Hany szennyviztisztito telep legyen a regionalis caatornaerndszeben?),

Toth, A., and Bulkai, L.

Hidrologiai Kozlony, Vol. 55, No. 4, p 164-167, April, 1975. 1 fig, 1 tab.

Economic and technological optimization of regional sewer systems and waste water treatment plants is described, based on optimization calculations for the regional sewer system planned for Lake Balaton in Hungary. The costs of regional sewer systems are composed of sewer and treatment plant costs. Increasing the number of waste water treatment plants in regional systems reduces the cost of the sewer system, as it becomes possible to reduce the diameter of the long-distance sewer pipes. The specific costs per cubic meter of treated waste water depend primarily upon the required degree of purification. Optimization calculations revealed the need for five mechanical waste water treatment plants for the Lake Balaton regional system when using the waste water for irrigation after settling for two hours. This optimum may be reduced to two to three plants if biological treatment is applied before discharge into recipients. One or two large-capacity treatment plants with three steps will be required for purification if the purified water is to be discharged into the lake.

*Sewerage, *Waste water treatment, *Treatment facilities, Regional development, Costs, Biological treatment, Waste disposal, Irrigation, Lakes

Lake Balaton (Hungary), Sewer pipes

B033
FORCE MAIN RUNS OBSTACLE COURSE,

Public Works, Vol. 106, No. 9, p 117, September, 1975.

The construction of a force main to connect the 126th Street bus depot in Corona, Queens, to the New York City sewer system involved tunnelling under 16 active railroad tracks operated by two different companies, a railroad station, a creek, and two 13,000-volt feeder cables. A boring machine was used to drill 180 feet north to the bus depot and 220 feet south to the sewer. Depending on the type of materials encountered by the machine, progress ranged from 1-2 ft/day to 30 ft/day. Twenty foot long sections of 30 inch steel pipe were forced ahead of the boring machine and joined to form a conduit for the 8 inch ductile cast iron main. The conduit is sized to be able to handle additional lines if needed in the future. After completion of the conduit and placement of the cast iron main inside, the main was attached to the casing by straps tack-welded by a man who crawled through the narrow tunnel with a supply of steel straps and welding equipment. It required five days to place 40 straps. A pump house constructed next to the bus depot provides the force necessary to move sewage through the main. The pump house contains an electrically operated duplex, vertical, submerged sewage ejector controlled by a transistorized, alternating pump panel housed in this building.

*Sewerage, *Sewers, Tunneling, Pipelines, Conduits, Steel pipes, Construction, Pumping plants

*Force mains

B034
MIAMI SEWER PLAN TAKES THE POSITIVE APPROACH,

Kay, J. J.

Water and Wastes Engineering, Vol. 12, No. 9, p 31-34, 36, September, 1975. 2 fig, 2 tab.

The city of Miami, Florida, has been implementing a program to provide new sanitary sewer systems and to upgrade its existing sewers. Combined sewer systems are not desirable as they place too severe a load on the sewage treatment plant during high intensity rain storms, and have very high pumping requirements and maintenance costs. Installation of sanitary sewers in South Florida depends on soil conditions, groundwater elevation, and depth of cut. In many cases, an apparatus called a "mule" is needed in sewer construction at moderately deep cut ranges where trench sidewalls have become unstable. When a large and deep trunk line is required, a "piggyback" sewer system is utilized, in which a minimum 8-inch diameter pipe is laid in the same trench and above the larger trunk line. Criteria for design of sanitary sewers include population density, groundwater infiltration, a minimum velocity of 2 feet per second, and an average daily flow of 65 gallons per capita per day. Infiltration problems may be alleviated with the specification that new joints for clay pipe and fittings will be factory bonded joints. Tests for leakage are performed before the acceptance of installation of new sanitary sewers. Replacement of 50 year old concrete pipes with vitrified clay pipe is also being done when major redevelopment within the public right-of-way occurs.

*Sewers, *Waste water treatment, *Sewage treatment, Florida, Construction materials, Design criteria, Pipelines, Joints (connections), Infiltration, Installation, Flow rates

*Sanitary sewers, *Miami (Fla)

B035
SEWER LINE INFILTRATION PROBLEM SOLVED,

Consulting Engineer, Vol. 45, No. 3, p 96, 98, September, 1975. 4 fig.

Repair of an interceptor line laid along a lake shore in Fayetteville, North Carolina, is described. Because the eight-foot sections of concrete pipe had been laid in gravel bedding in water-bearing sand, infiltration was a severe problem. Two thirds of the line had been installed below the lake level, and a continuous pressure existed on rubber compression gaskets and joints which could not be reduced by cement collars on the joints or by gel grouting. The infiltration problem was solved, however, with a system employing closed circuit television and an inflatable sleeve packer. The television camera was pulled through the sewer pipe, with the packer following. The packer was then positioned visually, inflated, and filled with a metered amount of 3M Elastomeric Sewer Grouting Compound and water. The grouting material was released and compacted under pressure and expanded up to ten times to fill the area with a flexible seal. Six months following this rehabilitation treatment, weir measurements were made to determine flow rates, and it was determined that the repair effort was successful.

*Sewers, *Infiltration, *Pipelines, Equipment, Joints (connections), Monitoring, Control systems, Remote sensing, Interceptor sewers, Polymers, Repair, Rehabilitation

*Television inspection, Grouting material

B036
GROUTING STOPS INFILTRATION IN LARGE-DIAMETER STORM DRAIN,

Public Works, Vol. 106, No. 9, p 82, September, 1975.

Infiltration into storm sewers has been prevented by a pipe rehabilitation system, applied to Lake Charles, Louisiana. Because the sewer lines were installed about fifteen years ago directly into water-bearing sand, water and sand infiltration have been a serious problem and shifting of the line's four-foot concrete sections has cracked the masonry grout in the joints. A permanent repair method was implemented, using a new hydrophilic polymer grouting material. The system requires a three-man crew and employs a group application probe, a three-element inflatable packer, and 3M's Elastomeric Sewer Grouting Compound. A faulty joint may be rehabilitated by manually positioning the packer inside the pipe barrel, holding the probe at the application point, and inflating the packer's two end elements to isolate the repair area. The grouting compound is then metered and mixed with water, and injected under pressure into the space between the packer's end elements. The center element is then inflated and compacts the compound into the joint. Because the grouting compound is a low viscosity liquid which expands up to ten times, the joint is filled with a tough but flexible seal within three minutes. After one year of rehabilitation, the system was found to still be preventing infiltration.

*Infiltration, *Polymers, *Sewers, *Rehabilitation, Storm drains, Construction materials, Joints (connections), Repairing, Pipelines

Grouting material

B037
STEEL SELECTED FOR TIGHT EFFLUENT LINE,

Brensley, A. A.

Warren and Van Praag, Incorporated,
Decatur, Illinois,
Consulting Engineers and Architects.

Public Works, Vol. 106, No. 9, p 96-97, September, 1975. 3 fig.

For the connection of a proposed activated sludge treatment stage of the Decatur, Illinois, Sanitary District to aerated lagoons, an effluent pipeline of the best appropriate material had to be chosen. Specifications for the effluent conduit included: a requirement for large size (36, 48, and 72 inches in diameter) conduit to meet limited head loss conditions; internal pressure of one to two pounds per square inch; pipes to be laid in shallow excavations, then covered by earthen embankments to a depth of 3 to 4 feet; and service roadways at given locations. While reinforced concrete pipe was the initial choice for the line, Armco Welded-Seam Helcor Smooth-Flow sewer pipe was found to be a suitable and less costly alternative. The basic material is corrugated steel, zinc coated, and the coils of corrugated steel are helically wound to form round pipe of a consistent diameter. The pipe has an asphalt covered exterior; the interior corrugations are also asphalt covered to a one-eighth inch depth. A combination of bolted connecting bands and rubber O-ring gaskets called Hugger joints, are used to link abutting lengths. Tightness of the joints was field tested, and air pressure held to within the required limits. Pipe installation operations involved several 20-foot lengths to be laid and bedded, followed by air pressure testing of their individual joints.

*Activated sludge, *Construction materials, *Pipelines, *Steel pipes, Sewers, Effluents, Joints (connections), Installation

B038
SUBMERSIBLE LIFT STATIONS CUT PUMP MAINTENANCE COSTS,

Water and Sewage Works, Vol. 122, No. 8, p 64-65, August, 1975.

Of 34 lift stations handling sewage for Foster City, California, 24 have recently been converted to the submersible pump type. About ten years ago, when the first pumping stations were installed in the city, types of stations included wet well with shaft-driven pumps, wet well/dry well, pneumatic ejector, and submersible. Maintenance and repair costs were high, and the majority of the pumps were difficult to remove for inspection or service. Moisture seeping into motors was a main problem. Since the installation of new Flygt submersible pumps, maintenance costs have been lowered considerably. Well structures have been modified and precise records are being kept on all stations and pumps. Semi-annually, each pump is removed from service and inspected. The pumps are washed and sandblasted down to bare metal, then exterior surfaces are recoated with bitumastic epoxy. This coating is necessary each six months to protect against corrosion from the high salt content of the waste water. Each submersible lift station has two or three pumps, so that at least one is available when the other is removed for maintenance work. An automatic control system for the sewage handling equipment pinpoints conditions at each pumping station and warns when there is a high liquid level in any well. Emergency generators are also available in the case of power failure.

*Pumps, *Sewage treatment, *Sewerage, *Waste water treatment, *Maintenance costs, Operating costs, Monitoring, Control systems, Sewer systems

*Submersible pumps

B039
SEWER INSERTION RENEWAL SAVES TOWN $2.5 MILLION,

Doan, R., Jr., and Broderick, M. T.

Amherst, New York, Town Engineer.

Public Works, Vol. 106, No. 9, p 72-74, September, 1975. 3 fig.

Amherst, New York, saved $2.5 million or almost 80% of the cost of conventional sewer renewal by inserting polyethylene pipe into their deteriorating collector. Thirty-six inch (OD) Series 80 "Aldyl" D polyethylene pipe was pulled through 48-in (ID) tile block collector. Application of the Manning flow formula proved that the smooth interior of the 32-in polyethylene pipe would offer little resistance to the flow. This reduced resistance to flow in the inserted pipe maintained the original flow capacity. Specifications for the insertion process included: descriptions for unloading and storing 90, 39-ft lengths of polyethylene pipe; construction of three winch shafts and two entry shafts; butt fusion of the polyethylene pipe; clearing the old pipe prior to insertion; the actual steps of the insertion; details of mechanical connections; directions for tapping the polyethylene pipe at the line's three manholes; provisions for assurance of flow in the parallel 8-in sanitary line; procedures and materials for grouting; and procedures and materials for laying concrete protection over mechanical connections. Each of these specifications is discussed. The process renewed 3400 feet of the sanitary collector, possibly the biggest sewer insertion renewal project ever attempted by a municipality. The success of the project prompted Amherst to commit municipal labor to massive insertion renewal of sewers throughout the town.

*Sewerage, *Repairing, *Plastic pipes, Sewers, Costs, Conveyance structures, Pipelines, Construction, Maintenance, Joints (connections)

Sewer pipe insertion, Polyethylene pipes

B040
LONGEVITY OF SEWER GROUT UNDER SEVERE CONDITIONS,

Calhoun, T. P.

Utilities Department,
Hollywood, Florida.

Public Works, Vol. 106, No. 10, p 80, October, 1975.

The performance of an acrylamide-based grout for the repair of sewer joints, which has been used since 1960, was evaluated in Hollywood, Florida. Because the area is involved in large amounts of sewer maintenance and rehabilitation, it was felt important that a grouted joint that had been exposed to severe conditions for several years be examined for deterioration. An 8-inch transverse main that had been grouted six years previous to examination was chosen. The joint was located in a section where sandy soil is periodically subjected to salt water intrusion, fresh water flooding, and prolonged dry spells. The line carries both domestic sewage and industrial waste. Visual inspection of the gel showed no signs of physical deterioration. While the soil was above the water table, no signs of grout desiccation were found. The gel ring was cut and the inside showed a solid matrix of sand and gel all the way through the pipe. Samples of gel were sent to be inspected in a laboratory that manufactures acrylamide-based grout. No indications of shrinkage or chemical degradation could be measured. Thus, the grouted joints appear to have a very long-term life expectancy and appropriations for further grouting have been approved.

*Construction materials, *Analytical techniques, *Sewer systems, Joints (connections), Pipelines

Grouting, Acrylamide

B041
SAM: A SEWER SYSTEM MODEL FOR PUBLIC WORKS ENGINEERS,

Davis, A. L., and O'Neel, W. G.

CH2M Hill,
Corvallis, Oregon.

Public Works, Vol. 106, No. 10, p 78-79, 120, October, 1975. 1 tab, 2 ref.

A System Analysis Model (SAM) for the city of Portland, Oregon, has been designed. This computer model simulates the overloading of the city's combined storm and sanitary sewer system in order to determine where overloading would have occurred and to determine the best route of waste water through the city's sewer system. The model arrives at its conclusion by developing hydrographs and hydraulic gradelines for sewer nodes (usually manholes), by calculating sewage flow from all sources, particularly from storm runoff, and by mathematically routing the sewage through the system. SAM is also used by engineers to keep an inventory of pipe size, length and condition, manhole volume and condition, and to keep maintenance information of all the components. It also has applications in sewer design and sewer system analysis. The SAM is compatible with the Portland IBM 1130 computer, and can be used for a small amount of initial data, offering the flexibility of changing data later. The model was designed in four separate routines to permit its use with the small capacity computer. The modules are storm runoff, sanitary sewage contributions, infiltration and inflow, and routed flow in the sewers. Existing quality routines can be expanded, and SAM can estimate the pollution impact of storm overflow. The model can also be linked to another one called DEAP, which designs, estimates the costs of, and plots new sewer lines. The ultimate usage of SAM is system control, which has been tested in the municipality of Metropolitan Seattle.

*Computers, *Model studies, *Sewer systems, Design criteria, Infiltration, Storm runoff, Manholes, Flow rates, Pipelines, Simulation analysis

Portland (Ore), System Analysis Model (SAM)

B042
THE AWAKENED INTEREST IN THE SEWER ORDINANCE,

Culver, R. H., and Saxon, T.

Camp Dresser and McKee Incorporated,
Boston, Massachusetts.

In: Proceedings of the 29th Industrial Waste Conference, May 7, 8, and 9, 1974, Part One, Purdue University, Lafayette, Indiana, p 565-573. 2 ref, 2 append.

The promulgation of regulations banning the discharge of untreated wastes has augmented the need for new sewer ordinances in many communities. It is now necessary to limit the discharges to the sewer system to those wastes that can be adequately treated by municipal treatment systems and which are not toxic to the system. In addition, PL 92-500 requires that all applicants for federal assistance in the construction of sewer works have a system of allocation of charges for sewer use. When planning for a new ordinance, decisions must be made on the design capacity of the system, the wastes which will or will not be treated, the administrative and operating body for the works, and the method which will be used to pay for the system. The ordinance should promote the best utilization of the sewer works that will achieve protection of public health, protection of the works, safety for the operating personnel, and efficiency of the treatment process. An ordinance generally consists of five parts. The first section defines all the special terms used in the ordinance and eliminates differences of interpretation that may cause dispute and litigation. A section on the conditions for discharge to the system describes who must discharge to the system, and the manner in which the connections are to be made. The last three sections include: the limitations on what may be discharged to the sewer; the powers of the authority to inspect, assign penalties, and prohibit discharges; and, a description of the cost assessments.

*Sewerage, *Legislation, *Local governments, *Waste water treatment, Sewers, Industrial wastes, Cost allocation

*Sewer ordinances

B043
SEWER PIPE RUN PASSES DEFLECTOMETER TESTS,

Water and Sewage Works, Vol. 122, No. 9, p 68-69, September, 1975. 8 fig.

A 900-ft run of ten-inch PVC gravity sewer pipe installed near Fredericksberg, Virginia, was field tested to assure that it met the engineering requirement of ten percent maximum deflection. Tests were carried out with a new electronic deflectometer designed and produced by HMJ Manufacturing and Sales. For this sewer line, which is part of a county-wide $5.5 million sewer and treatment project, the maximum PVC pipe deflection was found to be six percent. Average vertical deflections ranged from 2 to 3%; horizontal deflections tended to be lower. This sewer pipe has burial depths ranging from 27 to 39 ft, and the tested section originated near a recently-expanded pumping station. The pipe runs 4000 feet to discharge into an existing ten-inch line.

*Sewers, *Pipelines, *Plastic pipes, Construction materials, On-site tests, Analytical techniques, Engineering, Waste discharge

Deflectometer, Gravity sewers

B044
A FAIL-SAFE SUBAQUEOUS CONCRETE SEWER,

Emerson, G. G.

Ameron Pipe Products Group,
El Monte, California,
Southern California Division.

Civil Engineering-ASCE, Vol. 45, No. 9, p 77-78, September, 1975. 1 fig.

To improve the sewerage collection system for the city of San Diego, it was necessary to add a second sewer force main. Because the new pipeline would travel two miles subaqueously along the floor of the San Diego Bay, very stringent specifications for a leak-proof sewer force main were required. A concrete and steel joint was developed of a design using three O-ring gaskets and both bell and spigot elements at each end of each pipe section. The pipe itself is made of a rod-wrapped steel cylinder and cage and is encased in a 13-inch wall of vertically cast concrete. The configuration of a double mated joint system with a single O-ring gasket around a steel spigot and two O-ring gaskets around a doubled grooved concrete spigot provides a water-tight seal, protecting the steel joint rings from the effects of salt water. A unique minus-pressure technique is used to join the two pipe sections under water during installation. To place the pipeline in its location at San Diego Bay, material was dredged from the bay floor and released as native backfill over the pipe; the trench created was graded for pipe installation, and the pipe was submerged. When all three O-rings were in proper contact, as determined with a gage, a vacuum line was applied between the bells to pull the joint into a total, water-tight seal. An average of four 57-ton pipe sections were installed per day. Internal testing of each pipe joint plus cleaning of the annular space between O-ring gaskets were also performed.

*Sewers, *Joints (connections), *Pipelines, *Construction materials, *Concrete, Installation, Waste water treatment

Sewerage collection, San Diego (Calif)

B045
SEWER LINING--THE TORONTO TECHNIQUE,

Pellegrino, A. W.

Public Works Department,
Toronto, Ontario, Canada.

The American City and County, Vol. 90, No. 9, p 86-87, September, 1975.

A technique has been developed for increasing flow capacity in deteriorating sewer lines by the insertion of high density polyethylene pipe. This rehabilitation technique was used by the city of Toronto and was found to increase sewer capacity, decrease costs, and avoid leaking and infiltration. Prior to relining, a study of site conditions was made to determine locations of all private drains connecting to the sewer. Closed circuit television was used both to inspect the system for cracks, protrusions, and obstructions, and to observe the action of the reaming operation. Reaming out obstructions was performed from one manhole to the next, a distance of 300 feet. Maintenance of the reaming equipment, including daily motor and bearing lubrication, was essential to the success of the procedure. After the reamer had been used, the entire length of the sewer was flushed out to remove debris. The actual insertion of the plastic liner involved positioning a continuous fused length of pipe on rollers with a vibrating nose cone attached to it. The liner was pulled into the old sewer by means of a winch truck positioned over a manhole about 500 feet away. Immediately after the plastic liner had been inserted, lateral cutting and grouting was carried out to connect all drains. Over a mile of these linings have been inserted in Toronto, with no failures and a properly functioning sewer system in all cases.

*Plastic pipes, *Repairing, *Sewers, *Equipment, Pipelines, Maintenance, Infiltration, Equipment, Cleaning

*Reaming, *Television inspection, Toronto (Ont)

B046
PUMPS AND VALVES FOR THE WATER INDUSTRY,

Water Services, Vol. 79, No. 954, p 333-334, August, 1975. 1 fig.

Several pumps and valves for sewerage and water treatment have been developed in Great Britain. A new Tuke and Bell, Rolls Rotary positive displacement crude sewage pump was designed to solve large flow problems at pump fed, small sewage treatment plants. Each pump is rated at the preferred 1.5 times dry weather flow; a duty assist pump can provide a back-up three times dry weather flow when required. In another case, the problem of controlling sewage flow to a temporary treatment system has been solved with close coupled Freway vertical spindle pumps. These abstract a proportion of crude sewage at the inlet works in order to provide a constant BOD load on the temporary plant. Relief valves to ensure safety against external hydraulic pressures, particularly from high water tables in treatment tanks and pools, were also described. An 80-mm upward pressure relief valve has also been patented, which has flexible sealing faces to maintain an effective seal in the presence of sand and silt.

*Pumps, *Sewerage, *Valves, Water treatment, Waste water treatment, Flow rates, Sewage treatment, Treatment facilities, Sealants

Dry weather flow

B047
NEW SEWER SURVEY TV CAMERAS,

Water, No. 5, p 37, October, 1975. 1 fig.

A new sewer survey camera, manufactured by Seer TV Surveys Limited, Surrey, Great Britain, uses only a 12 volt supply to feed both the electronics and the remote control motors. These operate from a simple camera control unit established in the mobile survey unit. By eliminating the need to pass high voltage signals through the camera cable, the camera is more suitable for gas and chemical lines where high powered lighting increases the risk of lamp explosion and ignition of flammable substances. A low light level camera system was also manufactured which can achieve remarkable results using only up to 10 watts of light. The lamp is mounted in a sealed flashproof and impact resistant capsule which is situated at the front of the camera casing.

*Monitoring, *Sewers, Equipment, Control systems, Cameras, Remote sensing

Television inspection

B048
LARGE DIAMETER SEWER AVERAGES $234.50 PER LIN FT,

Engineering News Record, Vol. 195, No. 18, p 35, October 30, 1975. 1 tab.

The lowest prices for 5220 linear ft of 102-in diameter reinforced concrete gravity sewer averaged $234.50 per linear ft in a competition among 13 contractors for a suburban Washington, D.C. sanitary sewer project. The contract was taken for $2,596,944, 22% below the original engineering estimate, and 13.4% below the second lowest bidder. A 102-in diameter pipe and 920 linear ft of 72-in diameter concrete sewer pipe will be installed in trenches as deep as 22 ft that will parallel the Anacostia River. Project work will include building 150-in diameter steel lined tunnels to carry a 270-ft long section of pipe under a highway and another section 35 ft deep under railroad tracks. Additionally, a 24-ft deep manhole will be built to connect the 102-in diameter pipe to an existing line. Data are provided on the prices of various construction materials for the project.

*Costs, *Sewers, Concrete, Engineering, Tunnels, Manholes, Washington, Construction materials

Gravity sewers

B049
BROADER LOAN PROGRAM INTRODUCED FOR MUNICIPAL SEWERAGE PROJECTS,

Water and Pollution Control, Vol. 113, No. 9, p 18-19, September, 1975. 1 fig, 1 tab.

The federal government of Canada, through the Central Mortgage and Housing Corporation (CMHC) has passed new legislation to provide additional financial assistance to provinces, municipalities, and municipal sewerage corporations. Eligible projects for aid are defined. These include: sewer treatment projects, such as treatment facilities, and trunk collector sanitary sewers; trunk storm sewer systems; and regional sewerage plans. Loans for sewage treatment facilities, trunk collector sanitary sewers, and trunk storm sewer systems may be made in an amount up to two-thirds the eligible cost of the project. Loan forgiveness is also possible, for about one-sixth of the eligible project costs as determined by CMHC, or 25% of the principal and 25% of the acrued interest with respect to loan advances as at the date of project completion. Grants are also made for the establishment or expansion of a sewage treatment project or the construction of a trunk storm sewer system where no loan has been made by CMHC. Grants are also available when the cost of a sewage treatment project imposes an excessive per capita burden on taxpayers. Additionally, CMHC may make a grant to a province or municipality not exceeding one half the cost of the preparation of a Regional Sewerage Plan. Eligible project costs are defined, including construction costs, land costs, and the related costs of design and supervision, legal services, interim financing during the construction period and other costs as approved by CMHC.

*Legislation, *Loans, *Sewers, *Sewerage, *Treatment facilities, Costs, Grants, Regional analysis, Design criteria, Municipal wastes, Financing

B050
LASER TUNNELLING GUIDANCE SYSTEM,

Water, No. 5, p 36, October, 1975.

A new laser guidance system was developed to improve accuracy in tunnelling. Marketed by Mini Tunnels International, Surrey, Great Britain, the guidance system uses a light sensitive quadrant in a 150 mm diameter steel tube which replaces the normal target for the laser beam. The value of light imposed upon each quadrant section serves a digital reader device fixed near the miner within the shield and gives a reading in millimeters of the shield deflection from datum. A repeater installed in the office is used to monitor the tunnel drive. A continuous gas sampling detector, also newly developed, performs routine gas detection in the tunnels and does not rely upon vulnerable portable equipment. This sensor runs from the tunnel lighting supply; two sensing tubes draw in samples from different points in the driving shield. In the event of dangerous gases reaching a predetermined threshold level, tunnel lights will flash a danger signal.

*Sewers, *Tunneling, *Lasers, *Construction, Monitoring, Equipment, Sensors, Tunnel construction, Remote sensing

Light sensitivity

B051
PLASTIC MORTAR PIPE SOLVES JOINT PROBLEM,

Carlson, C. A.

Water and Sewage Works, Vol. 122, No. 9, p 84-85, September, 1975.

The Southern Laguana, California, Sanitary District has replaced a badly deteriorated 21-inch vitrified clay pipeline with a new 24-inch diameter reinforced plastic mortar pipe over a two mile area. As part of the sewer reconstruction project, the 21-inch clay pipe was crushed into aggregate-size particles inside the tunnel and was used as additional bedding for the replacement pipe. After a crusher had broken the old clay pipe and made new grade, new sections of ten-foot long (24-inch diameter) Techite pipe were transported to the site; laser equipment was used for alignment. This disposal method, by reusing the old pipe, saved the district over $100,000 in construction costs. Because access to public and private beach areas was necessary for the project, public relations were very important. Except for temporary storage of pipe, construction equipment, and tools, the impact on the ecology of the beach area was minimal.

*Sewers, *Pipelines, Plastic pipes, Construction materials, Recycling, Construction costs, Environmental effects

B052
CAPACITIES OF STACKS IN SANITARY DRAINAGE SYSTEMS FOR BUILDINGS,

Wyly, R. S., and Eaton, H. N.

National Bureau of Standards MN 31, July 3, 1961. 52 p, 41 fig, 16 tab, 20 ref, 3 append. (Reprinted with corrections June 1965)

An adequate knowledge of the hydraulics and pneumatics of building drainage systems is necessary for the computation of the minimum sizes of pipes that can be used satisfactorily in the various parts. Experimental studies of the hydraulics and pneumatics of plumbing systems conducted at the National Bureau of Standards and other laboratories since 1921 on the capacities of stacks and horizontal branches are discussed. The application of research results to the computation of loads for drainage and vent stacks is illustrated. Some of the loadings found in current tables of plumbing codes are compared with loadings computed in this paper. Conclusions are presented in the following areas: interference of flows at junctions of drainage stack and horizontal branches; flow capacities of drainage stacks; air flow in drainage systems; loading tables; distribution of air and water in cross sections of drainage stacks; velocity distribution of water in cross sections of drainage stacks; and, pneumatic pressures within drainage stacks. Additional research is needed on design flow and flow capacity problems.

*Plumbing, *Hydraulics, Hydraulic engineering, Drains, Drainage, Drainage systems, Flow, Pipes

Drainage stacks, Pipe sizes

B053
INVESTIGATION OF THE HYDRAULICS OF HORIZONTAL DRAINS IN PLUMBING SYSTEMS,

Wyly, R. S.

National Bureau of Standards MN 86, December 18, 1964. 38 p, 26 fig, 23 tab, 18 ref, 4 append.

An investigation of the hydraulics of flow in experimental equipment which simulated nominally horizontal simple and branching drains of plumbing systems is discussed. It is necessary to know the hydraulics of these drains when building sanitary drainage systems in order to rationally determine the minimum pipe sizes for these systems. Information concerning the hydraulics of sanitary building drains and building sewers as well as some of the factors which affect their hydraulic capacities are reported. Conclusions are presented for the following areas: estimating hydraulic capacity; design of plumbing systems with minimum venting; utilization of field data and of data on surge attenuation; effect of surge-duration time, drain slope, and other factors on hydraulic capacity; surge-flow capacities of simple drains; steady flow capacities of compound drains; capacities for surge flow superimposed on steady flow; and, computation of allowable fixture-unit loads. There is a need for further research in this area, especially in relation to hydraulic performance of drain systems as affected by steep slopes, drain storage volume, energy losses at stack bases, attenuation of water depths and discharge rates in long drains, and large drain diameters. The results of this investigation have important applications for the writing of plumbing codes and handbooks with respect to the optimum plumbing loads on building drains and building sewers.

*Sewers, *Plumbing, *Hydraulics, Hydraulic engineering, Hydraulic design, Pipes, Drains, Hydraulic gradient, Flow

B054
PLASTIC PIPE USE GROWS FOR SEWER MAIN INSTALLATIONS,

The American City and County, Vol. 90, No. 10, p 84, 86, October, 1975. 1 tab.

A survey on construction materials for sewer pipes showed that 19.3% of 1974 installations and an anticipated 18% of the 1975 installations were made with plastic pipe. Mileage of current sewer pipes are listed by type and by size range. The most common inplace sewer pipe material is vitrified clay pipe, followed by reinforced concrete, asbestos concrete, cast iron, and plastic. In recent installations, however, plastic pipe was the second most frequently used type, next to vitrified clay. Annual installations of over 16,500 miles of sewer pipe in the United States are predicted for the next five years, particularly in small cities and in southern and western communities.

*Construction materials, *Sewers, *Pipes, *Plastic pipes, Installations, Surveys, Concrete pipes, Cities

Vitrified clay pipes

B055
BIG BACKHOE BOOSTS SEWER FOOTAGES,

Roads and Streets, Vol. 118, No. 10, p 102-104, October, 1975.

High-speed trenching and setting of sewer pipes near Lakewood, New Jersey, has been achieved with a 5 cu yd hydraulic backhoe. The 60-in concrete pipe is being installed at 250 to 400 ft per nine-hour day in open country. A total of 30,000 ft of interceptor sewer pipe are being installed, mostly into open trench work. After the trench is cut and excess spoil is side-cast, dewatering is accomplished, using submersible pumps to bring down the water table. Special problems in this project involved: the 200-ft crossing of a shallow lake, completed by setting pipe between two lines of sheeting that formed a cofferdam; the jacking of heavy-walled 66-in concrete pipe at seven 70-ft intervals under highway and rail traffic crossings; and the steps required to protect the environment from noise and dust in urban areas.

*Sewerage, *Sewers, *Pipes, *Construction equipment, Pipelines, Pumps, Dewatering, Installation, Concrete pipes

Hydraulic backhoe, Trenching

B056
BACKHOE AND LOADER TEAM UP ON UNUSUAL SEWAGE SYSTEM,

Roads and Streets, Vol. 118, No. 10, p 110, October, 1975.

Sommer Construction Company of Nampa, Idaho, is building three large septic tanks to service an 80-home development, each tank servicing 27 homes. These septic tanks are each 8 ft high, 12 ft wide and 30 ft long, and are being constructed with a 3/4 cu yd P & H backhoe and a 2 1/2 yd loader. As the backhoe excavates, the loader moves spoil 50 ft back from the excavation. The loader then places a gravel base and drain pipes before the cast-in-place tank is installed. Excavations for the tanks measure 12 ft deep, 20 ft wide, and 36 ft long. The backhoe initially excavates a 12 ft deep, 10 ft wide, and 36 ft long section, then moves to complete the other half. Drain beds measure 12 ft deep, 30 ft wide, and 78 feet long, and excavation for both the tanks and drain beds requires about one week. After completing the excavations, a 10 cu yd dump truck hauls the gravel for bedding. A loader spreads the bedding and drain pipes can then be laid on a flat grade, and covered with another gravel layer. At the end of the construction process, the excavated material is returned to the hole by the loader.

*Septic tanks, *Waste water treatment, *Construction, *Sewerage, Engineering, Drainage, Pipes, Installation

*Backhoes

B057
GUNITING RESTORES A SEWER,

Garber, D. C.

Clapsaddle-Garber Consultants,
Marshalltown, Iowa.

The American City and County, Vol. 90, No. 10, p 102, October, 1975.

When a Tama, Iowa, storm sewer was severely damaged by heavy rainfall, complete replacement was not financially possible. Instead, it was decided to repair the system and increase the flow of runoff water. The rubble masonry walls of the sewer were cleaned, concrete roof slab was anchored to the walls, voids were filled with concrete grout, and weak spots were repaired. Wall surfaces were then smoothed by spraying gunite over wire mesh. The gunite seal, a mixture of cement, sand, and water, will be effective for several years. The restoration cost $34,000, or $6,000 less than the original contract estimate. The project was financed by road-tax money.

*Sewers, *Runoff, Costs, Repairing, Concrete, Cleaning, Rainfall, Flow rates, Cleaning

Gunite

B058
INTERCEPTOR SEWER COST ANALYSIS,

Paintal, A. S.

Metropolitan Sanitary District of Greater Chicago,
Illinois,
Sewer Design Section.

Water and Sewage Works, Vol. 122, No. 11, p 44, November, 1975.

An equation has been formulated to determine cost relationships for interceptor sewers, based on data gathered between 1963 and 1974 by the Metropolitan Sanitary District of Greater Chicago. Generalized cost equations for sewers do not exist. However, the cost of a sewage collection facility is approximately more than half of the capital cost of waste water disposal facilities. Cost relationships for interceptors can be expressed as: cost/mgd/mile=a(sewer capacity,mgd) to the bth power; cost/mile=c (sewer diameter) to the dth power; or cost/mile=e(service area population) to the fth power. The terms "a", "c", and "e" are constants and "b", "d", and "f" are power exponents, with sewer capacity expressed in mgd, sewer diameter in feet, and service area population in thousands. The data were analyzed to include construction costs only; legal and engineering fees as well as land acquisition and contingency costs were not included. Regression analysis of the data yielded the equations: cost $1000/mgd/mile=280(sewer capacity, mgd) to the -0.58th power and cost $1000/mile=250 (sewer diameter, feet) to the 1.13th power. These regression lines were plotted with the data. To develop the relationship between construction cost and service area population, it was assumed that the per capita sewage contribution was 100 gpd and that the peak to average sewage flow ratio x, is given by x=5/P to the 1/6th power (P being the service area population in thousands). By combining the first equation with these assumptions, the following expression was derived: cost $1000/mile=209(service area population in 1000s) to the 0.35th power.

*Sewerage, *Interceptor sewers, Costs, Treatment facilities, Waste water treatment, Equations, Engineering, Capital costs, Waste water disposal, Sewers, Regression analysis

B059
SEWER SYSTEMS IN THE COMMUNITIES AROUND LAKE SEVAN (Skhema kanalizatsii naselennykh mest, raspolozhennykh vokrug ozera Sevan),

Kotolikyan, S. S., and Zurgaryan, S. S.

Vodosnabzhenie i Sanitarnaya Tekhnika, No. 6, p 14-15, 1975.

Plans for sewer systems for the communities around Lake Sevan, an important recreational area in the Armenian SSR, are presented. The option of full biological purification in five waste water treatment plants followed by discharging the purified effluents into Lake Sevan, was compared with biological treatment of all effluents in a common treatment plant with subsequent discharge into a river beyond the Lake Sevan water capture area. While the first choice would be more economical than the second one, the latter was chosen because of the added safety it offered regarding water pollution prevention in Lake Sevan.

*Sewers, *Economics, *Lakes, *Waste water treatment, Biological treatment, Treatment facilities, Water pollution control, Water quality control, Waste disposal

Lake Sevan

B060
EXCAVATOR AND PUMPS CONQUER WATER TABLE,

Roads and Streets, Vol. 118, No. 10, p 96, 98, October, 1975.

A 20,000 ft network of deep sewer trenches was dug for a $6 million interceptor sewer system in Whiting, Indiana. The route of the system, which will handle both storm water and sewerage, was within 1000 ft of the shoreline of Lake Michigan. Because the trench was dug from 20 to 30 ft deep in a layer of fine silty sand loaded with organic materials, dewatering was a difficult process. To facilitate dewatering, deep wells were installed and pumping was done two months prior to excavation. Dewatering costs were about $300,000, and the process eliminated the need for putting down sheeting or distrubing traffic in the city's business district. A 4 1/2 cu yd hydraulic excavator with a steel trench box was used for excavation after the water table had been lowered. As each pipe section was positioned, it was fitted with a round steel plate to prevent inflow of sand or water. The plate was removed and reused for each new section. Each bell joint was coated with a non-shrink plastic sealing compound. The process cost $200 per day, but the cost was more than saved in cleanup expenses when the pipe was later inspected.

*Sewers, *Sewerage, *Dewatering, *Construction, Pumping, Wells, Equipment, Costs, Joints (connection)

Trenches, Sewer excavation, Water table

B061
REAL OR RASH REGIONALIZATION,

Capen, C. H.

American Water Works Association Journal, Vol. 67, No. 10, p 588-590, October, 1975. 1 fig, 1 tab, 19 ref.

Data on the populations, annual water supply volumes, and revenue for twenty-five large United States cities were compared. A surcharge is generally applied to rates for city water sold to suburban or outside areas, and cities have had difficulties in obtaining their desired compensation. In some cases, a district or regional administration has helped to overcome outmoded legislation. The cases of Philadelphia and Pittsburgh were cited, where a city is not serving water to noncity areas. Other utilities (such as in Louisville and Nashville) have expanded to include both water and sewer operations. The effects of a lack of standards and price-escalation controls has been felt in water rate controversies in New York and Chicago. In New Jersey, state, district, city, and suburban officials have overlapping and conflicting jurisdiction. A new water rate manual for sales to others, including both individual city control and regional or district control is greatly needed. More appropriate legislation for water rates was also recommended.

*Water supply, *Water rates, *Legislation, Administration, Sewers, State jurisdiction, Regional development

Water rate manual

B062
SANTA CLAUS SEWAGE SYSTEM NEARS COMPLETION,

Water and Sewage Works, Vol. 122, No. 10, p 79, October, 1975.

A sewerage system construction project in Santa Claus, Indiana, which cost $2 million was funded by a half grant, half loan from the Economic Development Administration (EDA). Sewage is processed in the $700,000 treatment plant at a rate of 500,000 gpd, and capacity can be increased to 800,000 gpd. The first phase of sewer line installation was completed in 1971. In December 1974, the Farmers Home Administration (FmHA) approved a loan of $1,360,000 and a grant of $250,000 to begin work on the final phase of the sewer system. This will serve primarily the domestic community as well as some light industry. All 118,000 feet of vitrified clay pipe have "O" ring compression joints; 18,885 ft of four-in diameter pipe, 2970 ft of six-in, 95,161 ft of eight-in, and 1036 ft of ten-in diameter pipe were supplied. Because much of the land in the area is hard rock formation, about 60% of the trenching had to be preceded by blasting with an air drill. Line and grade were monitored with a laser beam for laying the pipe. In the village area, 1850 new home sites are being built; each home lot carries a monthly $4 sewer charge to repay the FmHA loan.

*Sewerage, *Waste water treatment, *Sewage treatment, *Construction, Installation, Sewers, Municipal wastes, Industrial wastes, Clay pipes, Joints (connections)

Farmers Home Administration (FmHA)

B063
CROSS-CONNECTION CONTROL MANUAL,

EPA-430/9-73-002, 1973. 57 p, 35 fig, 4 tab, 13 ref, 8 append.

A cross-connection is a link or channel which connects a source of pollution with a potable water supply. The polluting substance tends to enter the potable supply if the net force acting upon the liquid is in the direction of the potable supply. Cross-connections present a public health problem. Well-documented cases exist where cross-connections have been responsible for the contamination of drinking water and the spread of disease. Control of cross-connections is possible by the application of knowledge and vigilance. All municipalities with public water supplies should have cross-connection control programs. This manual is designed as a guide for health officials, water works personnel, and plumbers to use in educational, administrative, and technical ways in conducting cross-connection control programs. Topics which are discussed include: public health significance of cross-connections; the theory of backflow and backsiphonage; methods and devices for backflow prevention; testing procedures for backflow preventers; administration of a cross-connection control program; and, cross-connection control ordinance provisions.

*Plumbing, *Pipelines, *Sewerage, *Water distribution (applied), Joints (connections), Water conveyance, Hydraulic engineering, Potable water, Water pollution sources, Public health

Cross-connections

B064
GETTING THE MOST OUT OF AN INFILTRATION/INFLOW ANALYSIS,

Jones, R. S., and Nelson, D. W.

Public Works, Vol. 106, No. 12, p 50-53, December, 1975. 1 fig, 5 ref.

Suggestions for compliance with the infiltration/inflow (i/i) requirements of the Construction Grants Program are presented. The accepted definition of excessive infiltration/inflow is the quantities of i/i which can be economically eliminated from a sewer system by rehabilitation. The term "excessive" has a purely economic meaning, and the determination of whether or not a sewer system is subject to "excessive" infiltration/inflow must be based on a cost-effective analysis comparing the alternatives of transportation and treatment to a combination of survey, rehabilitation, and transportation and treatment of the remaining extraneous flows. Commonly misunderstood legal requirements include: the provision that all flows within the service area throughout a 20-year planning period must be accounted for; the computation of the interest rate for amortization and present worth comparisons of operational and maintenance costs at 6 1/8%; and the correlation of the estimated rehabilitation costs with the flow rates and conditions observed in each individual sub-system.

*Infiltration, *Inflow, *Cost analysis, *Sewers, Waste water treatment, Waste disposal, Operating costs, Maintenance costs, Repairing

Infiltration/inflow, Cost effectiveness

B065
USING CORRUGATED STEEL TO SLASH SEWER COST BY 12%,

Jones, B.

Engineering and Contract Record, Vol. 88, No. 10, p 28-29, 32, October, 1975. 1 fig.

Twin conduits of corrugated steel pipe have been installed in the construction of a 518 m storm sewer for the City of Beltsville, Ontario. The use of this construction material, rather than reinforced concrete, resulted in a costs saving of $50,000. The 12-gauge steel pipe, called Smooth-Flo, has spiral configurations with a lock seam. Two annular corrugations were rolled into helical corrugations at each end of the pipe so that a coupling system could be accommodated. A coating of asphalt was spun onto the inside pipe surface after fabrication in order to improve hydraulic characteristics. Because the pipe is flexible, crushed stone laid to a minimum of 15 cm had to be compacted to cover the grade before the pipe could be bedded. Once in position, O-ring gaskets were installed and special Armco couplers were bolted together, providing a joint with low infiltration and exfiltration rates.

*Pipes, *Sewers, *Construction materials, *Steel, Pipelines, Waste disposal, Construction costs, Joints (connections), Asphalt

Armco coupler, Storm sewers

B066
PORTOBELLO LONG SEA SEWAGE OUTFALL TUNNEL,

Tunnels and Tunnelling, Vol. 7, No. 6, p 23-24, November/December, 1975.

Problems in the construction of a sea sewage outfall tunnel beneath the English Channel at Portobello have been caused by the upper chalk material in the path of the tunnel. Chalk has been encountered in three different conditions: highly fissured chalk underneath the foreshore, where fissures were either open and water bearing or full of soft putty chalk; good sound material with open fissures; or (presently encountered) highly fractured chalk with putty and virtually no strength. Due to the low strength of the chalk, stronger linings with bolt cast iron lining rings were required. In the final section of the tunnel, to be completed in 1976, driving must be preceded by extensive ground treatment. It was found that the critical factor in ground treatment is the interval at which probes are drilled. In highly fissured material an alternating pattern of four probes drilled to a 13 m length every 3 m of tunnel advance was necessary. It was also determined that several fissures could be grouted simultaneously through the same hole. Rapid hardening grout was used to reduce delay times.

*Sewers, *Tunnels, *Tunneling, *Outfalls, Construction, Sewage disposal, Grouting

*Chalk

B067
COATING IMMERSED CONCRETE FOR SWIMMING POOLS AND SEWAGE INSTALLATIONS,

Gay, P. J.

Journal of the Oil and Colour Chemists' Association, Vol. 58, No. 7, p 252-257, 1975. 1 fig, 10 ref.

Requirements for the protection of concrete sewer pipes and sewage treatment tanks are reported. Some of the chemical changes occurring during the curing of concrete are outlined and the mechanism of the corrosive effect of several types of waters on concrete structures is discussed. Structures in sulfate-bearing wet soil should be isolated from the water by a water-proof and vapor-proof membrane and the concrete should be a dense mix of low porosity. Surfaces should be painted by a dry mix using a siliceous aggregate and should be free from laitence and scum before painting. If greases or fats will be present as contaminants, chemically cured coatings, such as epoxies, should be applied.

*Sewage treatment, *Concrete, *Construction materials, *Pipes, *Coatings, Tanks, Paints

B068
THE SEWERLESS SOCIETY,

Leich, H. H.

Bulletin of the Atomic Scientists, Vol. 31, No. 9, p 38-44, November, 1975. 22 ref.

Adverse effects of sewer systems and traditional disposal methods include the risks of transmitting diseases downstream, the waste of large quantities of potable water to carry away small quantities of body wastes, high costs of sewer lines and treatment plants, eutrophication of lakes and estuaries, and increased build-up of sewage sludge. To solve some of these water supply and sanitation problems, it was recommended that sewage disposal systems be decentralized to the individual factory, apartment building, or home. In Sweden, Australia, New Zealand, Japan, and in parts of the United States, alternatives to sewer systems are being utilized. Seven of these waterless toilet systems are detailed: incinerating toilets, composting toilets, biological toilets, oil-flushed toilets, household collection systems, vacuum systems, and aerobic tanks. A partial listing (by brand name and manufacturer) of currently marketed sewerless toilets is also provided.

*Sewage disposal, *Waste disposal, Water supply, Water quality, Water pollution control

Sewerless toilets

B069
GROUTING SAVES SEWER LINE,

Water and Sewage Works, Vol. 122, No. 11, p 54-55, November, 1975.

A hydrophilic polymer grouting system has been used to restore the sanitary sewer system in Dumfries, Virginia, after considerable infiltration from Hurricane Agnes in 1972. New construction of sewer lines and re-excavation revealed that much of the infiltration was coming from smaller leaks in the O-ring collars of the collector lines. Rather than re-excavation, a two-man crew system was implemented. One man operated a closed circuit television monitor and control instruments in a mobile van, while the other operated a hand winch that pulled the TV camera, sleeve packer and a network of five feeder hoses through the line being repaired and inspected. The hoses were used to supply air, water, and Elastomeric Sewer Grouting Compound. When a leaking joint or crack was detected by the television monitor, an inflatable packer was opened against the pipe wall, isolating the infiltration area. An exactly measured mixture of the grouting compound and water was then injected into the packer's annular cavity. The polymer grout was compacted under pressure, expanding up to ten times to fill the infiltration area with a tough but flexible seal. The costs savings by grouting, rather than excavation, were about 90%.

*Sewers, *Repairing, *Polymers, *Waste water treatment, *Grouting, *Construction, Infiltration, Domestic wastes, Monitoring, Virginia

Elastomeric sewer grouting compound, Television inspection, Sewer lines

B070
THE EVOLUTION OF CORRUGATED STEEL PIPE,

Public Works, Vol. 106, No. 12, p 82-83, December, 1975. 3 fig.

Producers of corrugated steel see a breakthrough in new markets and new applications, resulting from developments such as corrosion resistant polymer coatings, 70 foot diameter pipes for small bridges, and other applications beyond drainage. At present, storm sewers are the scene of the biggest advance. Polymer coatings applied to galvanized pipe are a big breakthrough. Welded spiral corrugated pipe is watertight for pressure uses. Smooth interior pipe assures more efficient hydraulics. Corrugation configurations have been developed permitting pipe diameters of 6 inches to 70 feet and lengths up to 40 feet. Corrugated pipe is winning acceptance because of the work of field engineers of the National Corrugated Steel Pipe Association (NCSPA), who provide information to officials connected with the building trades. Sights are set on the storm sewer market. Replacements of old sewers as well as sewers at new construction sites are being projected. Corrugated steel pipe is less expensive by the linear foot than concrete, comes in longer lengths, is much lighter, and is more watertight at the connections. Other applications include: tunnels for transmitting utility lines from a central plant in multiple building sites; providing safety at golf courses; tunnels or hoods to protect outdoor conveyor belts; and other non-drainage uses such as trash chutes, air ducts, bank tunnels, and water tanks.

*Steel pipes, *Polymers, *Pipes, Construction, Tunnels, Sewers, Drainage, Construction materials

*Corrugated steel pipes, Drainage pipes, Non-drainage use, Storm sewers

B071
PROTECTING REINFORCED CONCRETE PIPE SANITARY SEWERS,

Kienow, K.

Water and Sewage Works, Vol. 122, No. 10, p 94-97, October, 1975. 1 fig, 1 tab, 1 ref.

A test program resulted in an equation from which the alkalinity of the inside of a concrete pipe could be determined. Design parameters on the life expectancy of centrifugally spun concrete pipe could be determined. Methods of increasing life expectancy have included adding extra concrete over reinforcing steel, using high alkaline aggregates, and using inert liners. An equation was published by the Environmental Protection Agency that relates the rate of penetration, or life expectancy, of a concrete pipe to the alkalinity of the inner wall. When concrete pipe is centrifugally spun high alkalinity results in the center. Tests have shown that such pipe has twice the corrosion resistance than conventionally made pipe. The alkalinity of the inside of the pipes was determined so that the designer could use the EPA information with regard to rate of penetration. Two methods are outlined. In one method, the time to penetrate the pipe wall is related to the alkalinity and the wall thickness. This product is known as the 'At' factor. In the most applied method, the time to expose the steel is related to the product of alkalinity and cover thickness over the reinforcing steel, 'Az'. This can be specified by the design engineer. The 'Az' number usually ranges from 0.20 to 2.25. The upper boundary corresponds to maximum sulfide values that usually occur in waste water. Various design examples are presented.

*Concrete pipes, *Sewers, *Alkalinity, *Pipes, Penetration, Rates, Design criteria, Engineering, Performance, Corrosion control

*Sanitary sewers, Centrifugally spun concrete pipes

B072
REHABILITATING AN 80-YEAR OLD SEWER SYSTEM,

Stein, M. E., Alfaro, A., Grgin, J. M., and Artale, J. V.

Parsons, Brinckerhoff, Quade and Douglas,
New York, New York.

Public Works, Vol. 106, No. 12, p 61-62, December, 1975.

The City of Albany, New York, began rehabilitating its 80-year old sewer system in 1966 by forming the Albany County Sewer District which then purchased the existing treatment plant from the city. The plan was to replace the treatment plant with a new secondary waste water treatment plant and maintain the Hudson River Interceptor with 18 existing and three new sewage flow regulators. Finally, the City of Albany would separate its combined sewers of two districts. The rehabilitation program ran into problems. The existing regulators were inoperative out-of-date, and difficult to reach under city streets. During the installatior of new equipment, old sewer lines could not be found, and when they could, they were found to be broken or incomplete. Redesigning storm sewers to eliminate street and basement flooding could not be paid for by the existing construction grants. Although the city did benefit by an exceptionally low bid for the first sewer district project, the estimated total cost to the city, minus grant funds, still amounted to $14.5 million. In addition, from 1970 to 1975, the percentage of tax exempt properties rose from 48% to 68%. It was recommended in this report that this type of problem, which could be repeated throughout the country, be corrected by legislation.

*Sewers, *Sewerage, Repairing, Waste water treatment, Sewage treatment, Treatment facilities, Construction costs, Legislation, New York

Rehabilitation, Storm sewers

B073
PLASTIC PIPE, PRESSURE SEWERS, MARK EXPANSION,

Williams, T. C.

Williams and Works,
Grand Rapids, Michigan.

Water and Wastes Engineering, Vol. 12, No. 11, p 85-87, November, 1975.

Innovative use of polyethylene pipe and installation of grinder pumps and pressure sewers marked the expansion that doubled the treatment capacity of the lagoon and irrigation system in Harbor Springs, Michigan. This is the first known use of polyethylene pipe for a collection system and the first use of grinder pumps and pressure sewers in a collection system in the state of Michigan. To serve a resort area, flexibility of operation was necessary to cope with population fluctuations, and scenic qualities of the area had to be protected. The project eliminates discharge of septic tank and treatment plant effluent into several lakes and streams in the area.

*Sewerage, *Plastic pipes, *Waste water treatment, Pipelines, Installation, Michigan, Treatment facilities

Polyethylene pipes, Pressure sewers

C001
DRAINAGE SYSTEM,

Alsberg, D. A. M., and Alsberg, G. R.

United States Patent 3,837,168. Applied June 18, 1973. Issued September 24, 1974. Official Gazette of the United States Patent Office, Vol. 926, No. 4, p 1181, September, 1974. 1 fig.

A drainage system has been patented which will reduce flooding and simultaneously recharge underground water supplies. The system consists of dry wells which connect to underground water sources, structures for carrying the water to the dry wells, and storage basins where excess water can be stored temporarily until the dry wells can discharge it to the water supplies.

*Patents, *Flooding, *Groundwater recharge, *Drainage systems, *Flood proofing, Flood control, Drainage wells, Drainage programs, Drainage water, Groundwater resources

C002
AERATION APPARATUS,

Di Gregorio, D., and Shell, G. L.

Envirotech Corporation, Salt Lake City, Utah

United States Patent 3,814,396. Applied February 16, 1972. Issued June 4, 1974. Official Gazette of the United States Patent Office, Vol. 923, No. 1, p 193, June, 1974. 1 fig.

A submerged aerator was patented which is comprised of a non-impelling bubble shearing mechanism rotating with and below an axial flow impeller which directs liquid downward past the bubble shearing device to entrain the sheared bubbles in the downward flow. This provides for increased retention of the sheared bubbles in the lower portion of the liquid body. The shearing mechanism has a hollow cylinder with an open bottom for receiving bubbles and a closed top concentrically secured to a rotating shaft, and a slotted sidewall through which bubbles pass to be sheared.

*Patents, *Aeration, *Water treatment, Aerobic conditions, Sewage treatment, Aerobic treatment, Equipment, Bubbles, Air entrainment

*Bubble shearing mechanism, *Axial flow impeller, *Submerged aeration device

C003
METHOD AND APPARATUS FOR FLUID COLLECTION AND/OR PARTITIONING,

Lawhead, C. M.

Corning Glass Works, Incorporated, Corning, New York

United States Patent 3,814,248. Applied February 23, 1972. Issued June 4, 1974. Official Gazette of the United States Patent Office, Vol. 923, No. 1, p 155, June, 1974. 1 fig.

Spools or partitioning assemblies have been designed to be used with rigid tubular containers for effecting the physical or the complete physical and chemical partitioning of the heavier fluid phase from the lighter fluid phase of a centrifugally separated fluid sample. Each spool has a central axial orifice and a resilient annular wiper portion. The wiper portion includes a container-contacting surface and is adapted to engage the inner surface of the container and an integral annular skirt portion. Because the specific gravities of the spools are between the specific gravities of the fluid phases, the spools move downward in the containers to the vicinity of the fluid phase interface. The lighter fluid phase flows upward through the central orifice. Physical partitioning occurs by the combination of a spool or spool-diagram with a natural plug of the heavy phase fluid, which acts to retain the heavy fluid phase. Complete physical and chemical partitioning is accomplished by combining a float apparatus and a spool to form a continuous line contact seal on the inner surface of the spool skirt portion. The partitioning assemblies can be used in evacuated fluid collection tubes or in atmospheric pressure tubes.

*Patents, *Water quality control, *Sampling, Equipment, Separation techniques, Centrifugation, Water analysis, Instrumentation, Homogeneity

C004
METHOD AND APPARATUS FOR FILTERING SOLIDS FROM A LIQUID EFFLUENT,

Ress, D. S.

Hydro-Clear Corporation, Avon Lake, Ohio

United States Patent 3,817,378. Applied March 5, 1973. Issued June 18, 1974. Official Gazette of the United States Patent Office, Vol. 923, No. 3, p 948-949, June, 1974. 1 fig.

The apparatus for this patented technique for filtering solids from a waste liquid is a sand filter. The filter tank has a layer of particulate matter forming a filter element with an upper surface, an underdrain cavity below the filter element, an effluent inlet above the surface, and a filtered effluent outlet connected to the underdrain cavity. A backwash outlet is located in the tank above the upper surface. Means are provided for pumping liquid into the underdrain cavity and up through the filter element, for directing fluid through the backwash outlet, and for energizing the pumping apparatus for backwashing. Fluid to be filtered is forced upward through the filter element and into the tank. The filtering occurs at different times than the backwashing. This increases the total filtering time between the necessary backwashings of the filter.

*Patents, *Effluent treatment, *Waste water treatment, *Filters, Filtration, Equipment, Effluents, Suspended solids, Water pollution treatment

Backwashing

C005
METHOD AND APPARATUS FOR MONITORING POLLUTION OF NATURAL WATERS,

Horvath, R.

Environmental Research of Michigan,
Ann Arbor, Michigan

United States Patent 3,852,997. Applied February 9, 1973. Issued December 10, 1974. Official Gazette of the United States Patent Office, Vol. 929, No. 2, p 540, Decerber, 1974.

Equipment to monitor natural waters which might be polluted by surface slick was patented. A combination of a first temperature sensor with wettable coverings; a second and similar sensor; and the means for wetting the coverings of each are illustrated. One sensor is immersed through the surface of liquid from a part of natural water which may be polluted and the other is immersed through the surface of natural water which is known to be unpolluted. Wet bulb temperatures are compared, and the difference between the two sensor temperatures is used as a determination of the amount of pollutant.

*Patents, *Analytical techniques, *Monitoring, *Pollutant identification, Natural streams, Water temperature

Water temperature sensors

C006
COALESCENCE OF SMALL SUSPENDED DROPS E. G. OIL FROM WATER,

Netherlands Patent 73745V/42. Applied March 30, 1973. Issued October 2, 1974. Derwent Netherlands Patents Report, Vol. 5, No. 42, p 1, November 26, 1974.

A system was patented for the coalescence of small suspended drops of oil from water. Liquid containing a finely divided contaminant such as suspended oil drops, is passed through a bed containing floating plastic balls, one to ten mm in diameter. The balls should be wetted by the oil. The flow should be in the direction in which the contaminant settles, upwards for oil in water. The oil drops collide with each other and the balls and coalesce. For deposits of lime, abrasion best removes them and the bed may be agitated for this purpose. The bed operates longer than conventional equipment without blocking.

*Patents, *Suspensions, *Oil pollution, Equipment, Water treatment, Lime, Contaminants, Water pollution control

Floating plastic balls

C007
REMOVING ORGANIC POLLUTANTS FROM WASTE WATERS,

Netherlands Patent 56761V/32. Applied March 28, 1973. Issued October 1, 1974. Derwent Netherlands Patents Report, Vol. 5, No. 42, p 2, November 26, 1974.

A patent was issued for a method of removing organic pollutants from waste waters. Hydrocarbons and other organic pollutants are removed by contacting them with a solid complex precipitated by treating a solid mineral or organic support with a halogenating agent, fixing unsaturated aliphatic or aromatic amines or a protein. The resulting pre-purified liquid is mixed with a water-immiscible hydrocarbon solvent, such as a 12-18 carbon paraffin fraction. The mixture is then passed through a bed of the complex to separate the solvent containing the organic impurities.

*Patents, *Waste water treatment, *Hydrocarbons, Water quality control, Organic compounds

Organic pollutants

C008
TRAP TO CLEANSE OIL-POLLUTED WATER,

Kharchenko, M. S.

Soviet Patent 410998. Applied February 7, 1972. Issued May 30, 1974. Derwent Soviet Patents Report, Vol. 5, No. 42, p 1, November 26, 1974. 1 fig.

A trap to cleanse oil-polluted water with a protective grid, injectors, flotation, and foam chambers was patented. To increase effectiveness of operation, each oil trap is in the form of a hull of varying sections with protective grills, consisting of, in sequence, a flotation chamber with air distribution injectors, a foam-forming chamber, a foam pumping-out chamber and a chamber for ejecting cleansed liquid. Fluid passes through a protective grid, entering a flotation chamber, where air from a compressor via injectors saturates the polluted liquid. Foam from a chamber is directed into the restricting chamber and then with the aid of a froth-suction manifold and a fan, it is directed into a pollution collecting tank. The cleansed fluid then passes through a chamber and is ejected.

*Patents, *Oil spills, Water treatment, Pollution abatement, Floatation, Equipment, Oil pollution

Traps

C009
APPARATUS FOR SKIMMING FLOATING POLLUTION FROM A LIQUID SURFACE,

Westerman, H.

United States Patent 3,849,308. Applied October 25, 1972. Issued November 19, 1974. Official Gazette of the United States Patent Office, Vol. 929, No. 3, p 1223, November, 1974.

A rocking skimmer for collecting liquid from the surface of a body of water has been patented. The apparatus consists of an open topped rigid container with walls that extend upward and a closed horizontal bottom. The container floats on the surface of a body of water and collects liquid. One of the end walls is shorter than the other end wall so that the wall can rapidly be submerged. The apparatus also has a floatation means to keep the container afloat when filled and to keep the container rockable about a transverse axis. There is a second floatation means that is interiorly seated in the container and adjacent to one end wall. The weight will rockably submerge the end wall below the surface of the water to collect liquid over the wall. The buoyancy of the weight is responsive to the collected liquid and will raise the wall clear of the surface of the water. The last part of the apparatus is a suction pipe with an open inlet. This is pivotally mounted on the transverse axis.

*Patents, *Equipment, *Separation techniques, *Oily water, Oil spills, Oil wastes, Oil pollution, Water pollution sources

C010
CORONA DISCHARGE TREATMENT OF AN OIL SLICK,

Stoddard, P. C.

United States Patent 3,865,722. Applied October 25, 1972. Issued February 11, 1975. Official Gazette of the United States Patent Office, Vol. 931, No. 2, p 813, February, 1975. 1 fig.

A process was patented which removes a non-emulsified, immiscible liquid hydrocarbon floating on the surface of a body of water. The oil is removed in a thin continuous layer. The method consists of positioning a corona-generating electrical lead above the liquid hydrocarbon, applying sufficient electrical energy to the lead to generate a corona, and subjecting the liquid hydrocarbon to the corona action. Electrical energy is applied until the oil slick becomes electrically charged and thus increases in its surface tension. The liquid hydrocarbon can then be removed from the water surface.

*Patents, *Oil wastes, *Waste treatment, Electrical equipment

*Liquid hydrocarbons

C011
APPARATUS FOR REMOVAL OF DISSOLVED OR SUSPENDED SOLIDS IN WASTE WATER,

Anderson, H. T.

Swift and Company,
Chicago, Illinois

United States Patent 3,865,711. Applied November 23, 1973. Issued February 11, 1975. Official Gazette of the United States Patent Office, Vol. 931, No. 2, p 810-811, February, 1975. 1 fig.

Equipment was patented to remove dissolved or suspended solids from waste water. Treatment of oil-water emulsion systems is facilitated by a container with entry and exit conduits and a baffle which extends across the width of the container. The baffle is positioned nearer to the inlet end than to the discharge zone and divides the container unequally into an inlet zone and a discharge zone. The lower section of the baffle is parallel to the inlet end of the container; the upper section of the baffle is inclined toward the discharge end. Cylindrical anodes in the inlet zone are spaced transverse to the longitudinal axis of the container while cylindrical anodes in the discharge zone are spaced parallel to the longitudinal axis of the container, at nearly equal distances apart.

*Patents, *Suspended solids, *Equipment, *Dissolved solids, *Oil wastes, Waste treatment

Oil-water emulsion systems, Solids removal

C012
APPARATUS FOR IMPROVED SHIPPING OF CRUDE OIL RELATIVE TO ENVIRONMENTAL DAMAGE AND ECOLOGICAL PROBLEMS,

Elson, J. M.

United States Patent 3,864,935. Applied March 22, 1973. Issued February 11, 1975. Official Gazette of the United States Patent Office, Vol. 931, No. 2, p 563-564, February, 1975. 1 fig.

A patent was issued for equipment for use in shipping crude oil between two geographical locations, in order to avoid oil spills. The oil is frozen into units for transportation. The transport units include equipment to freeze the oil into molds in the shape of geometrical forms. The transportation means include a tube through which the units of oil are to be transported; the tube's cross-section corresponds to the geometrical forms of the molds. The freezing apparatus also has the function of freezing water or a fluid other than oil. A description of the means for pouring oil into the containers, and for closing the containers is also given.

*Patents, *Oil, *Transportation, *Oil spills, Equipment, Environmental effects

Shipping

C013
DEVICE FOR RECEIVING WATER SURFACE FLOATING IMPURITIES,

Derzhavets, A. Y., Kogan, P. G., and Nunuparov, S. M.

United States Patent 3,862,902. Applied June 6, 1973. Issued January 28, 1975. Official Gazette of the United States Patent Office, Vol. 930, No. 4, p 1874, January, 1975. 1 fig.

A device was granted a patent for receiving of water surface floating impurities in the collecting receptacle of an oil and garbage skimmer craft. A gate is installed at the inlet end of the collecting receptacle with an upper horizontal edge which forms a weir. The upper layer of water and the flowing impurities overflow the weir. Means support the gate for free rocking movement about its horizontal axis. The gate also has an outer surface facing the water basin which is being cleaned; the surface consists of a cylinder with its longitudinal axis coextensive with the rocking axis of the gate. At least one float is fastened for rocking movement; a link forms a pivotal connection between the gate and the float. The link also provides a rigid connection between these, with a hydraulic cylinder and a hydraulic lock positioned in the link. The hydraulic cylinder provides for variation and setting in the length of the link whereby the immersion depth of the upper horizontal edge of the gate may be controlled with respect to the water level in the water basin which is being cleaned.

*Patents, *Water treatment, *Oil, Equipment, Waste treatment, Oil wastes

Oil skimmer

C014
BOAT FOR COLLECTING OIL SLICKS AND OTHER CONTAMINANTS FROM THE SURFACE OF WATER,

Weatherford, D. J.

United States Patent 3,862,904. Applied January 21, 1974. Issued January 28, 1975. Official Gazette of the United States Patent Office, Vol. 930, No. 4, p 1875, January, 1975. 1 fig.

A boat was patented for the collection of oil spills and other contaminants from the water surface. It consists of: a hull with a bow and stern; a fluid receiving compartment within the bottom of the hull; and a sluice gate in its bow for selectively admitting surface water into the receiving compartment. Oil collecting equipment is comprised of: a boom of several elongated flexible interconnected members floatable on water; a connection between the boom and one side of the bow on one side of the sluice gate with the other end fed through an opening in the hull of the boat; means for moving the boom through the opening in the hull to force the surface of the water within a loop formed by the boom to be moved into the sluice gate and then to a fluid receiving compartment; and, a pump connected to the compartment to remove fluid collected.

*Patents, *Oil spills, Liquids, Equipment, Contaminants, Pumps, Waste treatment

*Boats

C015
OIL SLICK SKIMMER,

Weatherford, D. J.

United States Patent 3,860,819. Applied January 5, 1973. Issued January 14, 1975. Official Gazette of the United States Patent Office, Vol. 930, No. 2, p 847, January, 1975. 1 fig.

A flat bottomed barge for removal of oil slicks was patented. It has one major compartment which extends the length and width of the barge. A second compartment extends below the first to receive liquid discharged. A sluice gate within the second compartment at the bow end selectively admits surface water. The opening and closing of the sluice gate varies the depth of this surface water. Jets pump out a water and oil mixture which is skimmed from a body of water. A pair of flaps is mounted at each side of the barge and from a closed funnel with a panel extending into the receiving compartment. The panel may be moved to various angular positions, with the flaps held in their places. The oil and water mixture is pumped into a container with a storage compartment; there oil is separated into a container and water is returned to the natural body of water.

*Oil spills, *Patents, *Equipment, Water pollution control, Oil pollution

Barges

C016
PROCESS FOR THE RECOVERY OF FORMALDEHYDE AND PHENOL CONTAINED IN WASTE WATERS,

Ackermann, J., Minora, G., and Radici, P.

Canadian Patent 963,592. Applied December 6, 1972. Issued February 25, 1975. Patent Office Record, Vol. 103, No. 8, February, 1975.

A patent was issued for a process for the purification of waste liquors. In this method, formaldehyde and phenol are recovered from the liquors by the addition of ammonia to the formaldehyde liquor. This forms hexamethylene tetramine. Water is evaporated, then the concentrate is added to the phenol liquor, thus recovering the hexamethylene tetramine/phenol adduct formed.

*Patents, *Waste treatment, *Phenols, Water reuse, Ammonia

Formaldehyde, Waste liquors

C017
OIL SKIMMER WITH OSCILLATABLE CIRCULAR LOOP,

Brill, E. L., and Brill, B. M.

Canadian Patent 963,398. Applied May 4, 1971. Issued February 25, 1975. Patent Office Record, Vol. 103, No. 8, February, 1975.

A patent was granted for a device to skim oil which is floating on top of a pool of water. The skimmer consists of an endless substantially rigid loop of a uniform cross-section. This loop is gripped at its upper edge by a pair of rolls which rotate in opposite directions and engage the loop at one zone in diagonally opposed quadrants. The rolls rotate the loop in its own plane and cause it to pass continuously in and out of the pool of water or hydrophilic liquid and thus to attract hydrophobic material such as oil. The oil or any colloidal material is then lifted by a coil and squeezed out as it passes through the rolls. The loop may oscillate about an axis substantially tangential to the loop at the driving zone.

*Oil spills, *Patents, Equipment, Water pollution control, Oil wastes

*Oil skimmer

C018
PROCESS FOR THE EXTRACTION OF PHENOL FROM WASTE WATERS IN THE FORM OF UREA-FORMALDEHYDE-PHENOL CONDENSATES,

Vargiu, S., Giovanni, S. S., Mazzoleni, G., and Pezzoli, S.

Societa Italiana Resina, S. R. R. S.p.A., Milan, Italy

United States Patent 3,869,387. Applied June 13, 1972. Issued March 4, 1975. Official Gazette of the United States Patent Office, Vol. 932, No. 1, p 229, March 1975.

A process was patented to extract phenol from waste water. Formaldehyde, urea, and waste containing 0.01 to 5 weight percent phenol are reacted for about 15 to 60 minutes at temperatures of 60 to 95 C and pH of 9.5. The molar ratio for formaldehyde to phenol is 2500:1 to 100 and of formaldehyde to urea about 2 to 2.7:1. This obtains a first reaction product, having a viscosity of 20 to 35 seconds measured at 25 C in a No. 4 Ford cup. This first reaction product is kept at the temperature of 60 to 95 C and pH of 4.0 to 5.5 for four to ten minutes to obtain a second reaction product with a viscosity of 35 to 60. The second product is reacted with additional urea and waste water containing phenol for 60 to 240 minutes at 60 to 95C and pH 5.7 to 6.8. A third reaction product with a viscosity of 75 to 110 seconds is obtained. This third and final reaction product is brought to a pH of about 8 and a condensate of urea-formaldehydephenol is formed and isolated.

*Patents, *Separation techniques, *Phenol, *Waste water treatment, Hydrogen ion concentration, Ureas

*Condensates, Formaldehyde

C019
PROCESS FOR CONTAINING OIL SPILLS,

Stanley, W. L., and Pittman, A. G.

United States Patent 3,869,385. Applied October 18, 1971. Issued March 4, 1975. Official Gazette of the United States Patent Office, Vol. 932, No. 1, p 229, March, 1975.

A process was patented for containing an oil spill on a body of water. A polyisocyanate and a polyamine are applied to the oil spill in such amounts as to furnish free isocyanate groups in approximately equimolar proportion to amino groups. Thus, both the polyisocyanate and the polyamine will have a density less than that of the water. They become at least partially miscible with the oil but essentially immiscible with the water, allowing for containment of the spill.

*Patents, *Oil spills, Oil pollution, Oil-water interfaces, Water pollution control, Pollution abatement

C020
SMALL-SCALE SEWAGE TREATMENT PLANT,

German Patent 63255V/36. Applied August 10, 1973. Issued August 29, 1974. Derwent German Patents Report, Vol. 5, No. 36, p 3, October 15, 1974.

A small-scale sewage treatment plant with detachable aeration and activated sludge recycling fittings was patented. It consists of an inner tank, which acts as the final clarification basin, and an annular space surrounding it. This space is divided by segments into two mechanical precleaning chambers in series and one chamber which can be converted into an activation basin by an aeration device. An activated sludge discharge pipe and an activated sludge recycling arrangement can be readily removed or inserted from the third chamber. The plant can cope with widely fluctuating input rates and can be operated as an activated sludge plant for mechanical-biological clarification. It can also be utilized as a mechanical settling basin with good clarification efficiency.

*Patents, *Sewage treatment, Activated sludge, Aeration, Recycling, Clarification, Treatment facilities, Biological treatment

Sewage treatment plant

C021
PLANT FOR TREATING WATER, IN PARTICULAR SEWAGE OR SLUDGE,

Bosshardt, E.

Sulzer Brothers Limited,
Winterthur, Switzerland.

United States Patent 3,854,875. Applied October 7, 1971. Issued December 17, 1974. Official Gazette of the United States Patent Office, Vol. 929, No. 3, p 1135, December, 1974. 1 fig.

A patent was issued for a sewage sludge treatment plant. The plant has a source of gamma radiation and duct means disposed about this gamma radiation source to provide a closed loop for the sludge. The duct means have at least two sections exposed to different sides of the source and define an unencumbered flow path for the sludge. Illustrated are means for forming a batch of sludge from a supply of sludge to be irradiated and a pump connected within and to the duct means for repeatedly circulating a delivered batch of sludge through the closed loop from a delivery side of the pump to an input side of the pump.

*Patents, *Gamma rays, *Sewage sludge treatment, Sewage, Pumps, Equipment

C022
SUSPENDED SOLIDS ANALYSER,

Australian Patent 453,333. Applied July 15, 1971. Issued September 27, 1974. Official Journal of Patents, Trade Marks and Designs, Vol. 44, No. 36, p 3993, September, 1974.

A system for detecting and measuring the concentration of suspended solids in a liquid was patented. A sensing device is adapted for submersion in a liquid containing suspended solids, and a power source is connected with this device. The sensing device consists of a housing with a light source and several photocells; each photocell is located at a different distance from the light source and is positioned to sense only light scattered backwards from the suspended solids. Conversion means are connected with the output terminals of the photocells for taking the logarithmic ratio of the photocell output signals to provide a single output, which is linearly representative of the solids concentration.

*Patents, *Suspended solids, Analytical techniques, Pollutant identification, Measurement, Sensing

Sensor devices, Power photocells

C023
METHOD OF PROCESSING SEWAGE,

Thorn, W.

Canadian Patent 957,443. Applied April 22, 1971. Issued November 5, 1974. Patent Office Record, Vol. 102, No. 45, p 45, November, 1974.

A new method of treating sludge was patented. The sludge is acidified with a mineral acid to a pH value just below 5; the pH value is then adjusted to the isoelectrical range of the high molecular sludge substances by the addition of hydrochloric acid. Floated hydrophobic substances are removed from the surface and the precipitated sludge is moved with calcium hydroxide or calcium and dehydrated in a filter press to a water content of 30 to 50 percent by weight. This process is less expensive than conventional processes and allows faster sludge dehydration.

*Patents, *Sludge treatment, *Dehydration, Hydrogen ion concentration, Precipitation (chemical)

Acidification, Filter press

C024
PRESSURE FILTER FOR WATER TREATMENT,

German Patent 74441V/43. Applied June 29, 1964. Issued October 17, 1974. Derwent German Patents Report, Vol. 5, No. 43, p 1, December 3, 1974.

A patent was granted for a pressure filter for water treatment, designed from pre-stressed concrete rings with integral filter plates. A closed horizontal pressure vessel with filter plates, fitted with filter nozzles, consists of a series of adjacently situated pre-stressed concrete rings with two end closures. These are clamped together by tensioning members running along inside the wall of the vessel. The concrete rings have parallel vertical side walls and curved arcuate upper and lower wall parts, with at least two integrally-formed filter plates extending over the full width of the ring between the parallel side walls.

*Patents, *Filters, Concrete, Construction materials, Pressure, Water treatment

Concrete rings, Pressure filters

C025
SEWAGE PURIFICATION TANK SEPARATION SYSTEM (Osui jokaso ni okeru bunri sochi),

Hanakawa, K.

Japanese Patent 49-21012. Applied August 7, 1970. Issued June 6, 1974.

When separating solid and sewage water by a sludge fermentation settling tank, usually the liquids and solids are separated by a net filtering. However, the accumulated solids and semi-solids on the net require some removal device so that part of the accumulation will not dry up and clog the net filter. A device designed to solve this problem was patented. The structure has a sewage chamber, a separation chamber, and a sludge fermentation (putrification) settling chamber. Each chamber's partition wall has an opening. In the separation chamber, a horizontal separation board with comb-like fine filter is placed either level or slightly inclined. Under the separation board, a water wheel turns with the separated trickling water and conveys the movement to an endless rotation belt. As the water wheel moves by the water separated from the scum it moves the belt and moves the comb filter so that the accumulated sludge will be moved and dropped into the sludge settling tank.

*Patents, *Sewage treatment, *Separation, Tanks, Settling basins, Filters

*Sewage purification, Japan

C026
BIOLOGICAL FERTILIZER PRODUCTION,

Belgian Patent 56760V/32. Applied March 2, 1973. Issued July 1, 1974. Derwent Belgian Patents Report, Vol. 5, No. 32, p 4, September, 1974.

A patent was granted for biological fertilizer production by treatment of sewage sludges with sulphite liquors. Fertilizer is produced using waste waters, such as agglomerated sewage, industrial waste waters, or agricultural waste liquors. These sewage sludges, obtained when the waste waters are clarified, are mixed with a residual sulphite liquor and reacted at an optimum pH of less than 6 in the presence of an oxidising agent. The treated sludges are then mixed with ground vegetable material and left to be transformed into a biological fertilizer by traditional methods.

*Patents, *Fertilizers, *Sewage sludge, *Sulfite liquors, Waste water, Industrial wastes, Agricultural wastes, Hydrogen ion concentration

Biological fertilizer, Clarification

C027
UNDERDRAIN STRUCTURE FOR WASTE EFFLUENT FILTER AND METHOD OF USING SAME,

Ross, D. S.

Hydro-Clear Corporation,
Avon Lake, Ohio

United States Patent 3,840,117. Applied April 30, 1973. Issued October 8, 1974. Official Gazette of the United States Patent Office, Vol. 927, No. 2, p 526, October, 1974. 1 fig.

A patent was given to an underdrain structure and method for waste effluent filtration. A waste effluent filter is included in a tank with a filter bed of particulate material, an underdrain cavity, and a lower portion. Means for draining from the underdrain cavity filtered effluent after the filtered effluent has passed through the bed, means for allowing air to enter the underdrain cavity, and means for forcing liquid into the underdrain cavity where the air is compressed are provided. One feature of this equipment is an air distribution device secured in the underdrain cavity which defines several vertically extending chambers below the bed. Each chamber has an inner cavity, a lower open end opening into the underdrain cavity and at least one means for forming an aperture in the upper end where liquid is forced into the underdrain cavity. The apertures have a second area substantially smaller than the first area, and liquid closes the open ends and then forces air entrapped in the chambers up through the aperture and then through the bed.

*Patents, *Filtration, *Sewage effluents, Drains, Liquids, Equipment, Tanks

Underdrains

C028
SEWAGE AND MUNICIPAL REFUSE LIQUID PHASE COKING PROCESS,

Hess, H. V., Wilson, R. F., and Cole, E. L.

Texaco Development Corporation,
New York, New York

Canadian Patent 954,810. Applied June 15, 1971. Issued September 17, 1974. Patent Office Record, Vol. 102, No 38, p 33-34, September, 1974.

A combination process for treating both municipal refuse and sewage was patented. Solid refuse is shredded and the shredded material obtained is mixed with a recycle stream of water resulting from a subsequent coking step to form a slurry. Non-combustible materials are removed from this slurry. The slurry is then mixed with sewage sludge, and the resulting mixture is coked under sufficient pressure to prevent the vaporization of water. Thus, grease, clean water, and clean coke are produced.

*Municipal wastes, *Patents, Sewage, Solid wastes, Water clarification, Liquids, Sewage sludge

Coking

C029
OXYGEN CONTENT AND B.O.D. OF EFFLUENTS MEASUREMENT,

German Patent 55341V/31. Applied May 9, 1973. Issued July 25, 1974. Derwent German Patents Report, Vol. 5, No. 31, p 2-3, July, 1974.

A patent was granted for oxygen content and BOD of effluents measurement. This involves an electrode with a movable collar which prevents fresh liquor from entering a cell during BOD determination. The electrode measures both the effectiveness of the oxygenation of an activated sludge process and the residual BOD. Oxygenation is measured by pumping the aqueous effluent past the cell. To measure biochemical oxygen demand, a collar is slid down, sealing on O-rings, and traps a sample within the cell. As the oxygen is consumed, the signal given declines and the BOD can be calculated from this rate of decline.

*Patents, *Biochemical oxygen demand, *Effluents, Measurement, Oxygenation, Electrodes, Activated sludge

C030
SLUDGE SETTLING DEVICE FOR SEWAGE FILTER SYSTEMS (Osui roka sochi ni okeru surajji no chinko bunri shori sochi),

Sasaki, J.

Japanese Patent 49-19659. Applied June 21, 1968. Issued May 25, 1974.

A patent was issued for a sludge settling device for sewage filter systems. In the treatment tank, sewage water is supplied by a pipe submerged deep in the sludge settling chamber. The sewage rises above to reach multi-filter material installed at the top of the chamber. The sludge settling device is a funnel shaped receptacle with a small outlet into the sludge removal channel. Between the filter material at the upper part of the sludge treatment tank and the sludge settling chamber is a frame bar with many slits through which the sewage water rises into the filter material. Many thin wire-like fibers are suspended from the frame bar over the entire cross section of the sludge settling chamber. Fibrous material accelerate sludge flocculation around them while sewage water moves up the tank between the hanging fibers. The flocculated sludge, growing in size and weight, can drop and slip into the outlet of the settling chamber and is drawn out by a suction pump. The purified water above the filter is emitted into the purification tank through a magnetic valve and is discharged by a pump.

*Patents, *Pumps, Filters, Sewage treatment, Equipment, Flocculation, Water purification

Sludge settling, Sewage filters, Japan

C031
PURIFICATION OF INDUSTRIAL AND MUNICIPAL WASTE WATER,

French Patent 36854V/20. Applied October 25, 1973. Issued June 28, 1974. Derwent French Patents Report, Vol. 5, No. 35, p 4, 1974.

A process for the purification of industrial and municipal waste water was patented. It reduces total organic carbon content and improves the color of water contaminated by organic compounds. The process is performed at 0 to 100 C. An amount of the contaminated water is introduced into a tank, adding active carbon to form a suspension. The mixture is stirred and contacted with an O2 containing gas, preferably by setting up a 1 to 9 mg/liter dissolved oxygen content. The amount of active carbon added provides a 50 to 200 g/liter suspension density of the contaminated water. After treatment active carbon may be separated from the water and reused for treating a further charge of water. Waste water color can be reduced from 500 to 1000 to less than 100 APHA color units.

*Patents, *Waste water treatment, *Carbon, *Organic compounds, *Municipal wastes, Dissolved oxygen, Color

*Total organic carbon

C032
OXIDATION DITCH FOR WASTE TREATMENT,

Australian Patent 452,527. Applied September 21, 1971. Issued September 5, 1974. Official Journal of Patents, Trade Marks and Designs, Vol. 44, No. 33, p 3641, September, 1974.

A method for the aeration treatment of waste liquid was patented. First the waste liquid is introduced into a ditch defining a continuous, substantially closed course for liquid movement with a surface level well above the ditch bottom. This waste liquid is then impacted with high velocity jets of a mixture of air and water, which is admitted below the surface level. This process imparts a velocity of at least about 0.3 foot per second to the waste liquid while mixing the air with the liquid. The treated liquid is thus removed from the oxidation ditch.

*Patents, *Aeration, *Liquid wastes, Jets, Waste treatment

*Oxidation ditch

C033
WASTE WATER (SEWAGE) PURIFICATION SYSTEM (Osui joka sochi),

Jomoto, T., Shinogi, K., Oshibi, M., and Terada, T.

Matsushita Electrical Engineering Company,
Japan

Japanese Patent 49-26661. Applied July 13, 1970. Issued July 11, 1974.

A sewage purification system was patented in which the circulation of sewage current in the aeration chamber moves only along the walls of the tank. The system contains a settling tank within an aeration tank in order to save space. The unit has a separation room, an aeration chamber, a settling chamber, and a disinfection chamber. The separation room has a sewage pipe which supplies the sewage water while the aeration room has air dispersion pipes. The settling chamber has a narrow upper part and a flared middle; near the top is an overflow opening. A sediment exit near its bottom returns the sludge to the aeration tank. There is a space between the settling chamber partition wall and the aeration room wall in which sewage water can circulate and oxidize well. Since the settling chamber has a flared bottom and a narrow top, the supernatant liquid forms a deep layer at the top and does not receive the effects of the circulation in the aeration chamber. The sediment returns to the aeration chamber from the exit near the bottom. The supernatant liquid overflows into the disinfection chamber where a disinfectant is supplied. The cleaned liquid is then emitted from the discharge pipe.

*Patents, *Sewage treatment, *Aeration, Disinfection, Equipment

*Settling tank, *Aeration chamber

C034
SEWAGE PROCESSING,

Turovskii, I. S., Goldfarb, L. L., and Gordon, B. L.

Soviet Patent SU 403632. Applied October 26, 1973. Issued March 20, 1974.
Soviet Inventions Illustrated, Vol. 5, No. 37, p 1, 1974. 1 fig.

A sewage treatment process was patented which coagulates chemicals, reduces emergency sludge areas, and eliminates a dehelminthisation chamber. Precipitates are fermented in a reservoir-storage tank, with aeration for 2.5 to 3.2 cu m/hr/cu m of precipitate for 12 to 48 hours, and then heated at 60 to 70 degrees C. These are then coagulated and dewatered. The sewerage supply pipes go from settlers and a sludge thickener to an aeration and storage tank. Pipes supply air to the latter. A heater, a mixer, a coagulant doser, a distributer, a combustion chamber, a drum vacuum filter, a belt conveyor, and a container for dewatered precipitate are illustrated. There is an emergency aerator-storage tank supplied with one cu m/cu m/hour of air. Heating and aeration make the materials non toxic and cut viscosity so that less ferric chloride must be added. After dewatering to 57% H_2O, the resultant liquid can then be stored. Capital costs are cut 2.5 fold and operating costs are cut by 15 percent.

*Patents, *Sewage treatment, *Sludge treatment, *Capital costs, *Operating costs, *Storage tanks, Aeration, Storage, Dewatering

C035
BIOLOGICAL PURIFICATION OF SEWAGE WATER,

Belgian Patent 61825V/35. Applied February 2, 1974. Issued August 12, 1974. Derwent Belgian Patents Abstracts, Vol. 5, No. 36, p 2, 1974.

A patent was issued for a method of biological purification of sewage water. The installation for the secondary processing of this sewage water has a tank divided into a series of compartments. In each of these there are partly submerged rotating discs, so that the fluid passes through the tank divisions at a controlled rate of flow. The bacteria propagate themselves while exposed alternately to the sewage and to atmospheric oxygen on the disc surfaces. The area of these disc surfaces are compared to the volume of the liquid being processed as held at its optimum ratio.

*Patents, *Sewage treatment, *Biological treatment, *Secondary treatment, Bacteria, Tanks

*Rotating discs

C036
SEWAGE TREATMENT TANK SCREENING STRUCTURE (Oshui shoriso yo sukurin kozo),

Sugimoto, T.

Japanese Patent 49-28359. Applied December 28, 1970. Issued August 2, 1974.

A patent was granted for a sewage purification device. In the system, sewage water led into a digestion tank or separation tank must first be filtered to remove solids. A simple filter screen quickly becomes clogged with the solids and requires frequent removal and washing. The use of a sweeper does not solve this clogging problem. A rotation drum screen also solves the clogging very little. This device was designed to remove screen-clogging solids periodically or at a desired time. The structure has several semi-circular segments joined by an inclined common axis. Each segment has a stable screen with a semi-circular bottom and teeth that will fit into the gaps of the semicircular screen perfectly. The rotation drum screen also provides a sweeper for the solids. The sewage water is supplied from a high level by a pipe at the top of the inclination, so that the solid will be screened and swept. As the drum rotates, the swept solid gradually is pushed toward the lower part, and finally pushed off into the solid receptacle.

*Patents, *Sewage treatment, Filters, Tanks, Equipment, Screens

*Rotation drum screens

C037
AUTOMATIC PRIMING OF WASTE-WATER PUMP,

French Patent 65042V/37. Applied November 13, 1973. Issued July 12, 1974. Derwent French Patents Abstracts, Vol. 5, No. 37, p 3, 1974.

An automatic priming system for a waste water pump was patented which will overcome siphoning due to failures in downstream drainage. This pumping unit is used to evacuate a waste water tank, especially one associated with a domestic unit, under level control, into a drainage system. The system has an inclined side-arm, branching below the non-return valve downstream of the pump, fitted with a valve which permits flow of air in either direction, but closes under pressure when the pump is in operation. The unit has a vertical Mono pump, below which is a rotary disc mill disintegrator. Backflow from the drainage system is prevented by a non-return valve. Should there be pressure loss in the drainage system due to leakage, siphoning through the non-return valve occurs, but it is prevented from de-priming the pump by entry of air or liquid through the sidearm. This serves to bleed away air during the initial start-up of the pump, and to equilibriate pressure in the pump when the non-return valve is closed, so that re-starting is facilitated.

*Patents, *Equipment, *Waste water, *Pumps, Automation, Drainage, Hydraulic machinery, Valves

*Waste water tanks

C038
APPARATUS FOR PREVENTING OIL POLLUTION,

Tuggle, R., Graves, R. H., and DeRouen, R. J.

Texaco Development Corporation,
New York, New York

Canadian Patent 964,475. Applied December 9, 1971. Issued March 18, 1975. Patent Office Record, Vol. 103, No. 11, p 16, March, 1975.

An oil pollution control device was patented. A segment of a substantial body of water is isolated and a segment of oil may be then introduced. The isolated portion extends from above the surface to near the bottom of such a water body. For example, a vertical caisson with its base extending into the bottom of the body of water and with openings just above the bottom may be utilized, permitting circulation of water at that level.

*Oil pollution, *Water pollution control, *Patents, Equipment

C039
USE OF MICROORGANISMS TO DISPERSE AND DEGRADE OIL SPILLS,

Mohan, R. R., Byrd, G. H., Jr., Nixon, J., and Bucker, E. R.

Exxon Research and Engineering Company,
Linden, New Jersey

United States Patent 3,871,957. Applied May 9, 1973. Issued March 18, 1975. Official Gazette of the United States Patent Office, Vol. 932, No. 3, p 1065, March, 1975.

A method was patented to protect beaches and shoreline solid surfaces against oil spills. This method consists of pretreatment of the beach or shoreline surface with a water slurry which has been prepared by admixing mutually compatible microorganism cells. These cells are selected from the group Arthrobacter, Micrococcus, and Achrombacter, with an inert absorbent substance. The mixture is dried at a room temperature ranging from 25 C to 55 C, and forms an anhydrous powder. This powder is then reconstituted with an aqueous phase, so as to generate a slurry and maintain the viability of the microorganisms. These then coat the beach or shoreline solid surface and disperse and degrade oil contamination.

*Oil spills, *Patents, *Microorganisms, Biological treatment, Slurries, Water quality control

C040
DENSE SOLVENT DEMULSIFICATION METHOD FOR BITUMINOUS PETROLEUM-WATER EMULSIONS,

Redford, D. A.

Texaco Exploration Canada Limited,
Calgary, Alberta, California

United States Patent 3,878,090. Applied September 27, 1973. Issued April 15, 1975. Official Gazette of the United States Patent Office, Vol. 933, No. 3, p 1339, April, 1975.

A process was patented for resolving an emulsion of water and bituminous petroleum, the specific gravity of the bituminous petroleum being essentially the same as the specific gravity of water. The method consists of contacting the emulsion with a treatment material which is soluble in the bituminous petroleum and essentially insoluble in water. This material is selected from the group consisting of carbon disulfide, carbon tetrachloride, chlorinated methane, chlorinated ethane, and mixtures of these. The volume ratio of treatment material to emulsion should be from about .01 to about 10.0.

*Patents, *Oily water, Emulsions, Waste treatment

Bituminous petroleum

C041
DEVICE FOR CLEANING WATER POLLUTED BY OIL,

Rafael, J.

United States Patent 3,875,062. Applied September 25, 1972. Issued April 1, 1975. Official Gazette of the United States Patent Office, Vol. 933, No. 1, p 341, April, 1975. 1 fig.

A patent was issued to a device for cleaning water polluted by oil. A floating body contains an inlet opening and a collecting chamber for the polluted water, the collecting chamber having a cover. The water surface polluted by oil inside the collecting chamber is fully or partially in contact with the cover; this cover is so arched that the oil accumulates, preferably at the highest point of the arch. Oil removal means are provided at the cover with the inside of the cover being below the minimum skimming height of the inlet opening.

*Patents, *Oil pollution, Water pollution treatment, Equipment

C042
SYSTEM FOR SEPARATING HYDROCARBONS FROM WATER,

Conley, J. D., Belden, D. E., and Terhume, R. D.

Fram Corporation,
East Providence,
Rhode Island

United States Patent 3,878,094. Applied November 27, 1972. Issued April 15, 1975. Official Gazette of the United States Patent Office, Vol. 933, No. 3, p 1340, April, 1975. 1 fig.

A system was patented for removing hydrocarbon pollutants from a water stream to provide a purified effluent stream. A separator removes free and entrained hydrocarbons from the stream; this separator has separate hydrocarbon and water outlets and a mechanical emulsion breaker for removing emulsified hydrocarbon from the stream. The emulsion breaker consists of an inlet connected to the separator water outlet, a control mounted to continuously sense the hydrocarbon-water interface in the separator, and valves for controlling the flow rates through the outlets. Controls are connected to the valves for adjustment of flow rates in response to changes in the position; the interface will counteract changes within. Thus the system is closed and pressurized. A fluid analyzer and an associated conduit continuously sample water effluent from the emulsion breaker and recycle the sample to the effluent stream.

*Patents, *Waste water treatment, *Separation techniques, *Oil wastes, Oily wastes

Oil-water separation

C043
SKIMMING DEVICE,

Falxa, H.

United States Patent 3,876,540. Applied May 18, 1973. Issued April 8, 1975. Official Gazette of the United States Patent Office, Vol. 933, No. 2, p 832, April, 1975. 1 fig.

A patent was issued for a device to skim a body of still liquid. The container is open at its top and has an aperture in its bottom connected to a pump, a set of floats, and means connecting the floats to the container in order to hold the upper edge of this container in a horizontal plane. Under normal working conditions the plane is beneath the surface of the liquid. The connecting means are comprised of several arms, each mounted to swing in a vertical direction about a point intermediate to its ends. One end of each arm is connected to one of the floats, and the other ends of the arms are connected to a nut vertically adjustable on a central threaded member carried by the container. Thus the vertical adjustment of the nut swings the arms in a vertical direction, altering the height of the container relative to the floats and to the liquid. Means then detect changes in a physical characteristic of the body of liquid being skimmed, and automatically adjust connecting means in response to those changes.

*Patents, *Waste treatment, *Liquid wastes, *Skimming, Equipment

C044
EXTENDED AERATION WASTEWATER TREATMENT,

Yang, J. T., Waller, R., and Mallory, C. W.

Hittman Associates, Incorporated, Columbia, Maryland

Canadian Patent 954,242. Applied December 15, 1971. Issued December 3, 1974. Patent Office Record, Vol. 102, No. 36, p 84, September, 1974.

A patent has been issued for an improved extended aeration process that is performed in a single tank. Wastes are aerated for periods ranging from 12 to 24 hours. During this time they are circulated in the tank in a controlled manner to avoid settling and compaction. The concentration of mixed liquor is maintained by the selective removal of clarified effluent. This eliminates the need for quiet zones for the settling of solids and for the return of compacted sludge to the aeration process. The apparatus is of modular construction and avoids the problems associated with sludge compaction. The preferred form is capable of being fabricated from planar elements either as a complete unit or as internals for installation in other types of tankage.

*Patents, *Aeration, *Waste water treatment, *Waste treatment, Sludge, Equipment, Clarification, Design, Construction

*Extended aeration

C045
METHOD AND APPARATUS FOR ANALYZING ORGANIC CARBON IN AQUEOUS SYSTEMS,

Miller, W. J., and Calcote, H. F.

United States Patent 3,814,583. Applied June 7, 1972. Issued June 4, 1974. Official Gazette of the United States Patent Office, Vol. 923, No. 1, p 242, June, 1974. 1 fig.

Organic carbon in an aqueous medium is burned and detected in a flame ionization unit. The water under analysis is atomized to a fine spray. The fine water spray travels into the combustion zone of a hydrogen flame where the organic carbon compounds are ionized. A collection electrode connected to an electronic circuit detects the ionized carbon compounds. Ion exchangers remove inorganic matter, for example, alkali metal salts, from salt-containing water, which could interfere with the analyzing process.

*Patents, *Aqueous solutions, *Carbon, *Equipment, *Ionization, *Ion exchange, *Metals, *Organic compounds, *Water treatment

*Flame ionization unit, *Ionized carbon compounds

C046
ENVIRONMENT MONITORING DEVICE AND SYSTEM,

Cox, P. F.

Texas Instruments, Incorporated,
Dallas, Texas

United States Patent 3,831,432. Applied September 5, 1972. Issued August 27, 1974. Official Gazette of the United States Patent Office, Vol. 925, No. 4, p 1153, August, 1974. 1 fig.

A monitoring system for determining the presence and concentration of selected substances in an environment was patented. Included in this system is a set of sensors providing outputs responsive to substances adsorbed from the environment. One of the sensors has a output differing from the others in the set in its response to at least one monitored substance. The sensors consist of adsorption field effect transistors respectively having chemically specific films in the gate region for the capability of preferential adsorption of preselected substances.

*Patents, *Monitoring, Control systems, Equipment, Environmental control, Adsorption

Sensors

C047
FLUID SAMPLING DEVICE,

Soudelier, M. A.

United States Patent 3,812,722. Applied June 21, 1972. Issued May 28, 1974. Official Gazette of the United States Patent Office, Vol. 922, No. 4, p 1074, May, 1974. 1 fig.

Fluid is sampled as it flows through a conduit by repeated expansion of a pressure chamber in an elongated tubular housing. This is projected into the flow conduit through a sampling outlet which is releasably clamped to the housing. A pressure chamber is formed between an inlet check valve and reciprocating piston, mounted on a discharge check valve, thro gh which fluid travels to a passage in the piston plunger during contraction of the pressure chamber. Responding to a predetermined pressure of the fluid in the plunger passage, a relief valve carried by the plunger opens to supply a fluid sample.

*Patents, *Sampling, *Water analysis, *Equipment, Liquids, Conduits

*Fluid sampling device

C048
LIQUID FILTER APPARATUS,

Hirs, G.

Hydromation Filter Company,
Livonia, Michigan

United States Patent 3,814,688. Applied August 30, 1972. Issued June 4, 1974. Official Gazette of the United States Patent Office, Vol. 923, No. 1, p 264-265, June, 1974. 1 fig.

A patent was issued for a liquid filtering device by which the polluting liquid is introduced between opposed, planar, horizontal filter media. It then flows simultaneously through the opposed media to accrete the pollutants on its confronting faces. The media are cleaned by interrupting the pollutant liquid flow and backwashing the upper filter media. Removable filter media can be discarded between the medial and lower chambers. This disposable filter is supported on a continuous conveyor and the medial and lower chambers may be separated to remove the disposable filter medium and the pollutants collected on both filter media.

*Patents, *Filtering systems, *Water pollution, Equipment, Filter media

Liquid filter apparatus

C049
BIOLOGICAL AERATED FILTERS,

Tymeszuk, J.

Lymflo Process Limited,
Montreal, Quebec,
Canada

Canadian Patent 953,039. Applied September 10, 1970. Issued August 13, 1974. Patent Office Record, Vol. 102, No. 33, p 85, August, 1974.

A process was patented for the treatment of domestic and industrial wastes and consists of a submerged biological filter bed of finely divided particulate filtering media. The wastes enter the biological filter bed and the filter is aerated during the filtration process. Treated effluent is drawn out of the biological filter bed; the bed being backwashed as often as necessary to maintain operating efficiency. The process is different from other processes because of the maintenance of a submerged and aerated filter bed.

*Filtering systems, *Patents, *Aeration, *Domestic wastes, *Industrial wastes, *Waste water treatment, *Water pollution, *Effluent treatment

*Biological aerated filters

C050
FILTER APPARATUS,

Timpe, A. M.

United States Patent 3,814,252. Applied August 18, 1972. Issued June 4, 1974. Official Gazette of the United States Patent Office, Vol. 923, No. 1, p 156, June, 1974. 1 fig.

From a source of supply, water is added to a first chamber, and from an exit opening in the lower part of the first chamber is welled up into a second chamber through a filter element. From the second chamber, water overflows on the filtered side through a fine screening element into a third chamber which is smaller in volume. It then flows to an outlet connecting with utilization pipes and a further inlet where such products as fertilizer may be admixed with the water. A low sidewall of the second chamber below the filter element may pivot to an open position, making removal of sediment possible by the water pressure entering from the first chamber.

*Patents, *Filtering systems, *Water treatment, *Water pollution, Water supply, Filters, Equipment, Screens

C051
WASTEWATER TREATMENT UNIT,

Rost, K. L.

United States Patent 3,825,119. Applied March 8, 1973. Issued July 23, 1974. Official Gazette of the United States Patent Office, Vol. 924, No. 4, p 886, July, 1974. 1 fig.

A unit for waste water treatment with a tank to receive the waste water and a chamber above the tank was patented and is adaptable to domestic use. Within the chamber is a filter with a downwardly and inwardly tapering fabric bag holding a trickling filter body, having its bottom end open and communicating with the tank. A pump in the tank pushes the waste water through a conduit which has a distributor or diffuser above the filter body, as well as a return pipe in communication with the tank with an aspirator for returning waste water to draw air into the tank. The return pipe next to the distributor is smaller in diameter than the distributor so that pressure can build in the distributor. This forces some circulating water through lengthwise slits and into the filter with solids continuing with the rest of the water into and through the return pipe. Water which passes through the trickling filter body down to the bottom of the bag returns to the tank. Water filtered by the bag is discharged from the unit. Time control may be exercised for use in aerating the tank contents by circulation of the contents.

*Patents, *Waste water treatment, *Domestic wastes, *Aeration, *Water pollution, Tanks, Equipment, Filters

C052
PROCESS FOR REMOVING POLLUTANTS FROM LIQUIDS,

Welch, R. M.

Liquid Waste Conversion Corporation, Churchville, Pennsylvania

United States Patent 3,839,206. Applied April 2, 1973. Issued October 1, 1974. Official Gazette of the United States Patent Office, Vol. 927, No. 1, p 243, October, 1974. 1 fig.

A system for removing contaminants from waste water has been patented. A flocculating chamber consists of a tubular housing with a baffle apparatus, a waste water inlet in the axial plane of the flocculating chamber, a flocculating agent inlet tangential to the axis of the chamber which provides a substantially helical flow of the waste water and matter entrained in the general axial direction of the chamber, and an outlet leading to a filter unit. The filter unit is constructed and arranged to filter out the floc formed in the flocculating chamber. The filtrate passes from the filter unit into a reverse osmosis chamber. The reverse osmosis chamber has a reverse osmosis membrane dividing it into inlet and outlet sections. An apparatus is present to apply predetermined pressure to the concentrated solution in the inlet section of the reverse osmosis chamber. The filtrate passes through the membrane and then through an outlet in the outlet section of the reverse osmosis chamber.

*Patents, *Waste water treatment, *Reverse osmosis, *Filtration, *Equipment, Flocculation, Filters, Membranes, Physical control

C053
RECIRCULATING SEWERAGE SYSTEM,

Cornish, A. J., Foster, C. W., and Campbell, A. J.

Kochler-Dayton, Incorporated,
New Britain, Connecticut

United States Patent 3,828,372. Applied January 24, 1973. Issued August 13, 1974. Official Gazette of the United States Patent Office, Vol. 925, No. 2, p 353, August, 1974. 1 fig.

A recirculating sewerage system was patented consisting of at least one water closet, a recirculating tank, including effluent receiving and pumping chambers divided by a common wall, and a drainage opening in the bottom of the recirculating tank. Included also was a pump with a filtering element for drawing liquid from the pumping chamber and for directing that liquid to the water closet for flushing. The separating common wall includes a filter to restrict the flow of bulk waste, such as paper products, from the chamber receiving effluent to the pumping chamber. There is also a sealing means to prevent effluent from passing to the effluent receiving chamber when a drainage valve is at its first position. Both chambers are drained by the displacement of the drainage valve to its second position which allows direct passage from each of the chambers to the drainage opening.

*Sewage treatment, *Effluent, *Waste water treatment, *Patents, *Equipment, Domestic wastes

Recirculating sewerage system, Water closet

C054
EFFLUENT TREATMENT,

Scragg, W. E.

Cadborough Engineering Company, Limited,
Hertford, England

United States Patent 3,817,848. Applied February 14, 1972. Issued June 18, 1974. Official Gazette of the United States Patent Office, Vol. 923, No. 3, p 1064-1065, June, 1974. 1 fig.

A patent was issued for a method and apparatus to treat effluent, primarily farm effluent, which stores effluent containing solids and fibrous matter in a storage container, then passes them into an aeration compartment after a portion of the treated effluent has been removed. Fibrous material with entrained activated sludge is removed by a rotary screen filter over the edge of an aeration compartment.

*Waste water treatment, *Effluent treatment, *Activated sludge, *Patents, *Sludge removal, Water pollution, Solid wastes, Agricultural wastes, Aeration, Screens, Filters

C055
WET OXIDATION TREATMENT OF WASTE LIQUOR OR SLUDGE,

Pradt, L. A.

Canadian Patent 958,507. Applied December 30, 1971. Issued December 3, 1974. Patent Office Record, Vol. 102, No. 49, p 2, December, 1974.

A patent was granted for wet oxidation treatment of waste liquor or sludge. Raw liquor or sludge derived from either sewage or industrial wastes is introduced to a heat exchanger. It then proceeds through a temperature control valve to a reactor, and to a separator. A flash tank is provided which receives oxidized liquor from the separator; another flash tank is provided which receives oxidized liquor from the separator at an intermediate pressure. This results in flash steam used for indirect preheating of the liquor or sludge by the heat exchanger in a single stage.

*Patents, *Waste water treatment, Oxidation, Waste treatment, Sewage treatment, Tanks, Sludge treatment, Industrial wastes

*Wet oxidation, Flash tanks

C056
WATER PURIFICATION SYSTEM,

Overton, C. E.

Overton Engineering,
Billings, Montana

United States Patent 3,841,483. Applied July 23, 1973. Issued October 15, 1974. Official Gazette of the United States Patent Office, Vol. 927, No. 3, p 980, October, 1974. 1 fig.

A flow-through water purification apparatus for separating suspended colloidal particles was patented. It involves: a body having an inlet at one end and an outlet at an opposite end, defining at least one passage between the inlet and the outlet; a first set of mutually spaced plates placed in the passage through the adjacent body inlet; a second set of mutually spaced plates placed in the passage to the intermediate body, between the first set and the outlet; and, a third set of mutually spaced plates placed in the passage through the adjacent body and downstream of the second set of plates. Means carried by the apparatus direct a flow of water to be purified through the inlet, into the passage, and sequentially through the plates in the first, second, and third sets, and subsequently through the outlet. Means coupled to each of the plates apply a preselected electrical potential across them so that the colloidal particles will be subjected to a predetermined ionizing potential. Two valve means, at the inlet and the outlet, control the flow. Sensor means at the inlet produce a signal proportional to the conductivity of the flow; second sensor means at the outlet produce a signal proportional to the resistivity of the flow.

*Water purification, *Patents, Colloids, Suspended solids, Separation techniques, Equipment, Flow control

C057
WATER CLARIFICATION WITH NITROGEN-HETEROCYCLIC PHOSPHONIC ACIDS,

Redmore, D.

Petrolite Corporation,
Wilmington, Delaware

United States Patent 3,859,211. Applied August 26, 1971. Issued January 7, 1975. Official Gazette of the United States Patent Office, Vol. 930, No. 1, p 432, January, 1975.

A patent was issued for water clarification with nitrogen-heterocyclic phosphonic acids. This process of water clarification consists of the step of addition to water containing suspended matter of nitrogen-heterocyclic phosphonic acids (and derivatives thereof characterized by at least one aminomethyl or aminosubstituted methyl, phosphonic acid group or its derivative), bonded directly, or indirectly through a N-aide chain, to the nitrogen atom of the heterocyclic ring. This is selected from the group consisting of an imidazoline, a tetrahydropyrimidine, a piperazine, a morpholine and an additional structure illustrated.

*Patents, Organic compounds, Water purification, Acids, Nitrogen

Suspended matter, Nitrogen-heterocyclic phosphonic acids

C058
A WASTEWATER TREATMENT SYSTEM,

Hoermann, W.

New England Wastewater Systems,
West Dover, Vermont

United States Patent 3,850,808. Applied October 19, 1972. Issued November 26, 1974. Official Gazette of the United States Patent Office, Vol. 928, No. 4, p 1702, November, 1974. 1 fig.

A waste water treatment system was patented. Its components are: a storage treatment tank having a receiving chamber for accommodating waste products with a perforated filter screen; an aeration chamber adjoining the receiving chamber of the tank which receives solids and liquids of a predetermined size; diffusing means for introducing air under pressure for aerating the fluid contents of the aeration chamber; a first settling chamber for separating solid portions of the fluid from its liquid portions; a second settling chamber adapted to receive liquid from the first settling chamber; feedback means to return too high density portions of the contents to the receiving chamber for further processing; a storage treatment tank having an outlet for discharging portions of the contents of the second settling chamber; aerating and distribution means connected with the storage treatment outlet to provide further aeration; diffusing means for introducing air under pressure into a distribution box aeration chamber; and an additional settling chamber.

*Patents, *Waste water treatment, *Tanks, Storage, Filters, Aeration, Liquid wastes

Storage tanks, Settling chambers

C059
WASTE TREATMENT PROCESS,

Jeris, J. S., Beer, C., and Mueller, J. A.

United States Patent 3,846,289. Applied June 19, 1972. Issued November 5, 1974. Official Gazette of the United States Patent Office, Vol. 928, No. 1, p 260, November, 1974. 1 fig.

A process for denitrifying waste water containing nitrified waste was patented. The waste water is passed through a bed of microorganisms; the bed is adapted to pass suspended solids present in waste. The process involves: generating an upflow fluidized bed of denitrifying biota, attached to a solid particulate carrier, the carrier having a particulate size from about 0.2 to 3.0 millimeters and a specific gravity of at least 1.1; passing waste water up through the bed at a flow rate of at least six gallons per minute per square foot of bed to buoy the particles, to overcome the influence of gravity, and to impart movement to the bed particles; providing sufficient amounts to a carbon source in the waste water to allow the nitrified wastes to be converted to nitrogen by the biota; maintaining the bed at a temperature sufficient to permit biota activity; and, removing excess biota growth formed on the carrier during the process.

*Waste water treatment, *Denitrification, *Biological treatment, *Nitrogen, Microorganisms, Flow rates, Waste treatment, Gravity, Patents

Biota

C060
WASTEWATER TREATMENT SYSTEM,

Karr, F. A.

Canadian Patent 959,182. Applied August 28, 1972. Issued December 10, 1974. Patent Office Record, Vol. 102, No. 50, p 74, December, 1974.

A patent was issued for a waste water treatment system. An apparatus and method are described for injecting air or other oxygen-containing gases under pressure into waste water from within a gas porous shell capable of passing gas bubbles of a size of 1 to 2 microns or less for retention by the waste water. The injection may be through elements at the bottom of a sump or on stream in a recycle line to and from the sump. A bed of perforate balls on the bottom of the sump provides an excellent surface area for bacterial treatment by coated enzymes injected into the system.

*Patents, *Waste water treatment, *Oxygen, Sumps, Biological treatment

Oxygen injection, Bacterial treatment

C061
WASTEWATER TREATMENT SEQUENCE,

Zuckerman, M., and Molof, A.

Canadian Patent 957,789. Applied May 4, 1970. Issued November 12, 1974. Patent Office Record, Vol. 102, No. 46, p 74, November, 1974.

An improved process for treating waste water was patented, based on pre-treatment by hydrolysis. This converts high molecular weight soluble organic material in raw waste water into organic material of low molecular weight. Following this conversion, the waste water is treated with a process sequence tailored to effluent quality requirements. One such sequence may include, for example, the steps of physical or biological adsorption, solids removal, membrane filtration, and disinfection.

*Patents, *Waste water treatment, *Pre-treatment, *Hydrolysis, Biological treatment, Organic matter

C062
SEDIMENTATION APPARATUS WITH PLURAL SLUDGE DISCHARGE FEATURE,

Smith, E. J.

General Signal Corporation,
Rochester, New York

United States Patent 3,857,788. Applied April 27, 1973. Issued December 31, 1974. Official Gazette of the United States Patent Office, Vol. 929, No. 5, p 2052, December, 1974. 1 fig.

A sedimentation apparatus was patented, including a tank having a base and an encircling side wall. It also contains means for supplying sludge-containing influent to the tank, which has a sludge hopper in its base, means for maintaining a predetermined fluid level in the tank, and means within the tank for collecting and transporting sludge settling on the base to a common location in the sludge hopper. These means include a rotary raking structure supported in the tank for rotation about the central vertical axis of the tank. Sludge pick-up means remove sludge of uniform consistency from a common location. A rotating spout connected to the sludge pick-up means discharges uniform consistency sludge to a place of distribution from a first and a second conduit.

*Patents, *Sedimentation, Tanks, Sludge treatment, Waste discharge, Conduits

C063
SEWAGE TREATMENT WITH PRIMARY SLUDGE REMOVAL FROM FINAL CLARIFIER,

Walker, J. D.

Chicago Bridge and Iron Company,
Aurora, Illinois

Canadian Patent 959,584. Applied April 2, 1971. Issued December 17, 1974. Patent Office Record, Vol. 102, No. 51, p 83, December, 1974.

A method of sewage treatment with primary sludge removal from a final clarifier was patented. The primary settling tank is omitted or reduced in size; the primary type of sludge is carried through the aeration tank by vigorous circulation of its contents, then removed from the system at the final clarification tank. Sludge settles on the floor near the entry to the clarifying area and is scraped separately into a hopper as waste sludge. All sludge settling further remote from the feed is removed from several points for rapid return of a portion of them to the aeration tank. The reduction of primary settling provides an inventory of fine inert particles. In the aeration tank, these particles adhere to the light activated sludge flocs to increase their weight and aid settling in the clarification tank.

*Sewage treatment, *Sludge treatment, *Patents, Settling basins, Tanks, Aeration, Clarification, Sludge disposal

Settling tanks, Clarification tanks

C064
SEWAGE TREATMENT SYSTEM,

Milne, G. A.

United States Patent 3,859,215. Applied April 21, 1972. Issued January 7, 1975. Official Gazette of the United States Patent Office, Vol. 930, No. 1, p 434, January, 1975. 1 fig.

A sewage treatment system was patented. It is composed of a closed ambient pressure operating aeration tank, having a cylindrical wall oriented around a generally horizontal axis. This maintains rotary flow of sewage in the tank and has ends joining the wall in completion of closed chamber. The aeration tank also has restricted openings receiving a sewage inflow pipe, an effluent outflow pipe, a solids return pipe, an oxygen input pipe and an open atmospheric vent pipe. The aeration tank cylindrical wall is disposed underground and is completely covered by a usable recreation surface. The various pipes are open to atmospheric pressure; the tank is also open to atmospheric pressure. An underground clarifier is connected to the distal end of the outflow pipe spaced from the aeration tank; the outflow pipe discharges into the clarifier; and the solids return pipe is connected to the clarifier and extends from the clarifier to the aeration tank.

*Sewage treatment, *Patents, *Pressure, *Pipes, Waste discharge, Aeration, Tanks, Clarifiers

C065
PROCESS FOR THE REDUCTION OF THE BIOCHEMICAL OXYGEN DEMAND OF SEWAGE AND FOR THE RECOVERY OF THE INHERENT PROTEIN,

Hollo, J., and Zagyvai, I.

Canadian Patent 959,586. Applied December 7, 1970. Issued December 17, 1974. Patent Office Record, Vol. 102, No. 51, p 83, December, 1974.

A process for the reduction of BOD of sewage was patented in which the inherent protein is recovered. Sewage is purified by adding to it at least 120 g/cu m of a water-soluble aluminum salt or a bivalent or trivalent iron salt, and possibly 0.5 to 1.0 kg/cu m of bentonite or kaolin, as well as five to ten g/cu m of copolymers of acrylic acid-acrylic amide in the form of an aqueous solution. Sewage is then conditioned, its pH is adjusted to exceed ten by adding a basic calcium compound, and the protein-containing precipitate thus obtained is separated from the clarified water in a settling tank. The pH of the precipitate is adjusted to seven or less using carbon dioxide. After dehydration the precipitate may be sterilized at temperatures above 130 C under pressure.

*Sewage treatment, *Patents, *Biochemical oxygen demand, *Proteins, Polymers, Precipitation (chemical), Hydrogen ion concentration, Dewatering, Alum, Iron

Copolymers, Dehydration, Protein recovery

C066
PROCESS FOR PRODUCING AND MAINTAINING PURIFIED, STERILE WATER,

Hickman, K. C. D.

United States Patent 3,860,494. Applied August 29, 1972. Issued January 14, 1975. Official Gazette of the United States Patent Office, Vol. 930, No. 2, p 841, January, 1975. 1 fig.

A process was patented for producing and maintaining purified sterile water from impure water. Impure water is evaporated and condensed, and the resultant distillate is collected in a vertically disposed storage zone. The zone has a permanent blanket of steam above the distillate; steam is supplied by evaporation of impure water. Fresh distillate is supplied from evaporation of impure water and the condensation of the resulting vapors, to the upper end of the storage zone which is already substantially filled with the steam-blanketed distillate. Simultaneous removal of distillate from the zone and maintenance of the zone in a substantially filled condition is achieved. Removed distillate is recycled back to the evaporation step for repurification.

*Patents, *Water purification, Water treatment, Evaporation, Vapors, Storage, Water quality

Steam distillation

C067
PROCESS OF AND INSTALLATION FOR PURIFYING SEWAGE,

Brucker, C.

United States Patent 3,846,291. Applied August 7, 1972. Issued November 5, 1974. Official Gazette of the United States Patent Office, Vol. 928, No. 1, p 261, November, 1974. 1 fig.

A patent was granted for a sewage treatment plant. It consists of a basin with an upstream and a downstream end; there is a flow of progressively treated sludge toward the downstream end. A sewage intake is located at the upstream end; a treated water outlet is located at the downstream end. A travelling bridge is mounted for reciprocating movement along the basin between the upstream and downstream ends; sludge aerating and recycling means are mounted on this bridge, forming a sludge circuit. This includes a suction intake located adjacent to the bottom of the basin, a suction pump means for drawing the sludge from the bottom of the basin through the suction intake, and nozzle means constructed and arranged for receiving sludge from the pump means. Sludge is aerated by spraying it into the air, the effective direction of the sprayed sludge being toward the upstream end of the basin. The sludge is continually recycled in an upstream direction counter to the downstream flow of the progressively treated sewage.

*Patents, *Sewage treatment, *Treatment facilities, Sewage sludge, Sludge treatment, Pumps, Aeration, Recycling

C068
OXYGENATION OF WASTE WATER,

Garbo, P. W.

United States Patent 3,855,120. Applied July 5, 1973. Issued December 17, 1974. Official Gazette of the United States Patent Office, Vol. 929, No. 3, p 1202, December, 1974. 1 fig.

An improved process for treating BOD-containing water by biochemical oxygenation was patented. It comprises flowing the BOD-containing water and oxygenating gas simultaneously up through an elongate mass of solid contact particles with a maximum dimension not exceeding ten millimeters. The mass contains active biomass, regulates the upflow of BOD-containing water and oxygenating gas, and effects expansion and turbulence of the mass without effecting transport of solid contact particles away from the mass. This expansion of the mass increases its volume when in a settled state by at least ten percent. The turbulence of the mass causes uniform dispersion of the oxygenating gas as tiny bubbles in the BOD-containing water, whereby biochemical oxygenation is achieved. Treated water rises and is withdrawn above the top of the expanded and turbulent mass of solid contact particles.

*Waste water treatment, *Biochemical oxygen demand, *Patents, Oxygen, Turbulence, Bubbles, Dispersion, Biomass, Oxygenation

Biochemical oxygenation

C069
METHOD FOR THE PRIMARY AND SECONDARY TREATMENT OF WASTEWATER IN A UNITARY APPARATUS,

Torpey, W. N., and Sullivan, R. A.

United States Patent 3,849,304. Applied August 9, 1973. Issued November 19, 1974. Official Gazette of the United States Patent Office, Vol. 929, No. 3, p 1222, November, 1974. 1 fig.

A method was patented for the continuous treatment of waste water. Its steps are: providing a treatment tank with a primary bay and at least one secondary bay horizontally adjacent to the primary bay; including a lower settling zone and a vertically adjacent upper biological treatment zone in each bay; introducing waste water into the lower settling zone of the primary bay; creating a flow of waste water through the settling zone of the primary bay; vertically directing waste water from the settling zone to the upper biological treatment zone; creating a flow of waste water through the biological treatment zone countercurrent to the direction of waste water flow through the settling zone of the primary bay; horizontally directing waste water from the biological treatment zone of the primary bay to the biological treatment zone of the secondary bay; creating a flow of waste water through the biological treatment zone of the secondary bay; vertically directing waste water from the biological treatment zone of the secondary bay into the lower settling zone of the secondary bay; creating a flow of waste water through the settling zone of the secondary bay countercurrent to the direction of waste water flow through the biological treatment zone of the secondary bay; and, removing the waste water from the settling zone of the secondary bay.

*Patents, *Waste water treatment, *Biological treatment, Flow control, Primary treatment, Secondary treatment

Continuous treatment, Settling zones, Currents

C070
METHOD AND APPARATUS FOR USE IN WATER PURIFICATION BY REVERSE OSMOSIS,

Gibbs, E. L.

Ultrascience Incorporated,
Skokie, Illinois

United States Patent 3,846,295. Applied April 6, 1972. Issued November 5, 1974. Official Gazette of the United States Patent Office, Vol. 928, No. 1, p 262, November, 1974. 1 fig.

Patented was a method of solvent purification of an impure solvent by reverse osmosis. Steps involve supplying impure solvent at one side of a membrane, applying a pressure to the impure solvent sufficiently greater than the osmotic pressure to produce a reverse osmotic flow through the membrane, and withdrawing the concentrate forming at the input side of the membrane. A predetermined cyclic pulsed flow is used, whereby the solvent flow across the input face of the membrane is similarly pulsed. Flow is restricted during periods of maximum flow to a predetermined amount which will not impair flow through the membrane, but will provide flow turbulence over the membrane surface with adequate flushing for prevention of excessive boundary layer formation at the membrane. Any boundary layer formation and particulate disassociation during intermediate periods is materially countered by the maximum flow and period duration of the maximum flow period.

*Patents, Water purification, Reverse osmosis, Flow, Membranes, Turbulence, Solvents, Flow characteristics, Water treatment

Flow turbulence

C071
METHOD AND APPARATUS FOR SEPARATING PARTICLES FROM A LIQUID,

Condolios, E., and Van Essen, U.

United States Patent 3,849,310. Applied March 25, 1971. Issued November 19, 1974. Official Gazette of the United States Patent Office, Vol. 928, No. 3, p 1224, November, 1974. 1 fig.

A patent was issued for a method of separating particles from a liquid, consisting of a basin which from top to bottom is composed of four parts, one on top of the other. These are: a cylindrical upper front part forming an overflow edge and surrounded by a discharge gutter; a downwardly diverging second part; a third part having a cylindrical section which is greater in diameter than that of the upper part, in which a screen divides the third part into a portion over and a portion under the screen, the solids being able to pass through the perforations of the screen; and, a lower part composed of several funnels, each funnel constituting a collecting tank and having a discharge outlet for particles separated from the liquid.

*Patents, *Separation techniques, Liquids, Tanks, Equipment, Waste treatment, Waste discharge

Collecting tanks

C072
EXHAUSTIVE ELECTROLYSIS METHOD FOR DETERMINATION OF OXYGEN DEMAND,

Cummings, J. P.

Honeywell, Incorporated,
Minneapolis, Minnesota

United States Patent 3,857,761. Applied December 1, 1972. Issued December 31, 1974. Official Gazette of the United States Patent Office, Vol. 929, No. 5, p 2044, December, 1974. 1 fig.

An exhaustive electrolysis method for determination of oxygen demand was patented. The method consists of placing an aqueous sample for oxygen demand determination into an electrolytic cell having a pair of electrodes in contact with the sample. This includes an anode within an anode compartment, a cathode remote from the anode compartment, and an ion permeable membrane in contact with the sample to provide an electrolytic bridge between the anode and the cathode. An alkali metal hydroxide is added to the sample until the pH of the sample is greater than ten. An electrolyzing current is then applied across the electrodes at a potential suitable for the generation of oxygen along the sample contacting surface of the anode, until the sample is electro-inactive and maintains a substantially constant temperature. Finally, measurement is made of the partial pressure of oxygen evolved from the anode-sample interface during the period when the sample is substantially electro-inactive.

*Patents, *Electrolysis, Cathodes, Anodes, Analytical techniques, Samples, Liquids, Membranes

Oxygen demand

C073
EJECTOR AERATED OXIDATION DITCH FOR WASTE TREATMENT,

Lecompte, A. R., Jr.

Kimberly-Clark Corporation,
Neenah, Wisconsin

United States Patent 3,846,292. Applied October 5, 1973. Issued November 5, 1974. Official Gazette of the United States Patent Office, Vol. 928, No. 1, p 261, November, 1974. 1 fig.

A patent was given to a system for treating waste liquid containing settleable solids and BOD. Its components are: an oxidation ditch for confining and retaining the waste liquid, defining a continuous, closed flow path through which the confined liquid is moved, with a liquid depth of at least ten feet, and several ejectors for aerating the waste liquid in the ditch to reduce the BOD and to simultaneously move the waste liquid through the flow path. The ejectors are capable of circulating the waste liquid throughout the ditch at a velocity of at least 0.3 foot per second to maintain the settleable solids in suspension. Each ejector comprises a housing with a waste liquid inlet for receiving a stream of pressurized waste liquid; a high velocity waste liquid nozzle discharges a waste liquid-air jet to this inlet. Ejectors are arranged to discharge the waste liquid-air jets at least nine feet below the surface of the waste liquid in the oxidation ditch and in the direction of movement.

*Patents, *Biochemical oxygen demand, *Waste treatment, *Aeration, Liquid wastes, Solid wastes

Ejector, Oxidation ditch, Settleable solids

C074

ELIMINATION OF WATER SURFACE POLLUTION,

Australian Patent 458,317. Applied November 6, 1970. Issued February 27, 1975. Official Journal of Patents, Trade Marks, and Designs, Vol. 45, No. 6, p 542, February, 1975.

A patent has been issued for a composition that can be used for the elimination of water surface pollution. The composition is in a granular or powdered form and is suitable for concentrating organic pollutants on the surface of a body of water. The components of the composition include a carrier having an apparent density of less than one g/cc, a wetting agent consisting of a mono or polyhydric alcohol, and a surface active agent having a hydrophilic group other than a hydroxyl group. In each 100 parts by weight of the three components, there are 10-90 parts carrier, 1-10 parts wetting agent, and 9-80 parts surface active agent.

*Patents, *Water treatment, *Water pollution control, *Organic wastes, Pollutants, Organic wastes

C075
BIOLOGICAL PURIFICATION OF WASTE WATER AND SEWAGE,

French Patent 11433W/07. Applied April 18, 1973. Issued December 20, 1974. Derwent French Patents Report, Vol. W, No. 7, p 3, March 25, 1975.

A biological treatment process was patented for waste water and sewage coming from small and medium sized communities. The method involves total oxidation (extended aeration) in which crude effluent is admitted directly into an oxidation-settlement tank. This tank is equipped with a floating turbine to stir and homogenize the medium with an intense introduction of oxygen. This causes direct oxidation, allowing aerobic bacteria to live and multiply. After the aeration phase, the turbine is stopped and settlement takes place. The sludge falls to the bottom and the upper layer rapidly becomes limpid; it is evacuated through an automatic overflow valve. After the evacuation of the purified water, the valve closes and the plant may begin another cycle.

*Waste water treatment, *Patents, *Biological treatment, *Sewage treatment, Oxidation, Sludge treatment, Aeration, Aerobic treatment, Bacteria, Treatment facilities

Extended aeration

C076
SEWAGE AND EFFLUENT BIOLOGICAL TREATMENT PROCESS,

Belgian Patent 82653V/48. Applied July 2, 1974. Issued November 4, 1974. Derwent Belgian Patents Report, Vol. 5, No. 48, p 2, January 7, 1975.

A patent was granted for a sewage and effluent biological treatment process which uses oxygen in counter-current flow with liquid containing suspended oxidizable matter. The plant facility is designed for activated sludge treatment of sewage, industrial effluents and fermentation liquors. Liquid to be treated enters a series of covered oxygenation tanks; these communicate with each other through openings in the separating partitions. Automatic valves control the oxygen content of the gaseous phase, held at a predetermined value. Oxygen or air enriched with oxygen circulates counter-current to the liquid. The treated liquid leaves the last tank to pass into a separating tank from which the settled sludge is recycled back to the first tank. With regular oxygen feed into the various tanks, better operating conditions result: consumption of oxygen is reduced; the energy balance is improved; and the dimensions of the settlement tank can be reduced.

*Sewage treatment, *Patents, *Oxygen, Biological treatment, Effluents, Valves, Waste water treatment, Liquids, Tanks, Separation

Countercurrents

C077
WATER TREATMENT WITH OZONE,

Netherlands Patent 32218U/23. Applied May 4, 1973. Issued November 6, 1974. Derwent Netherlands Patents Report, Vol. 47, No. 1, p 1, December 31, 1974.

A patent was issued for a method of water treatment with ozone. Water is treated with filtration and reduction of the ozone residue steps. The filter bed is described. This is composed of a uniform mixture of granular inert natural or synthetic microporous material, as well as granulated activated carbon of a similar physical nature. The best types of natural or synthetic components are those which are chemically reactive.

*Patents, *Ozone, *Water treatment, Filters, Activated carbon, Construction materials, Filtration

Filter beds

C078
AERATING EFFLUENT AND KEEPING SLUDGE IN SUSPENSION,

French Patent 57251V/32. Applied January 29, 1974. Issued September 27, 1974. Derwent French Patents Report, Vol. 47, No. 5, p 3, December 31, 1974.

A process was patented in which effluent is aerated and activated sludge is held in suspension by jets of water obliquely striking the surface. The vessel used may be circular, eliptical or polygonal in plan and is of constant cross-section through the greater part of its height. Jets strike the surface at not more than 60 degrees, preferably 10 to 20 degrees to the surface with a speed of between 3 to 12 m/sec (preferably 4 to 8 m/sec). The horizontal component of the tangent is in the general direction of the flow.

*Patents, Aeration, Effluents, Suspensions, Sludge, Jets, Waste treatment, Flow, Activated sludge

C079
VALVE FOR CONTROLLING LIQUID DISCHARGE,

Netherlands Patent 81931V/47. Applied May 1, 1974. Issued November 6, 1974. Derwent Netherlands Patents Report, Vol. 47, No. 5, p 2, November 11, 1974.

A patent was granted for a valve for controlling liquid discharge, with a plastic frame defining an opening, a plastic flap, and a hinge. This tide valve is to be placed on the banks of waters with a varying liquid height, and is especially useful for discharging sewage into tidal waters. It has a plastic frame, made of a substance such as polyvinylchloride, defining an opening and a plastic flap, such as of asbestos-reinforced PVC, hinged for closing the opening. The flap is placed in the open end of a tube piece, with the flexible plastic hinge fastened to the frame and the flap, and is protected against damage. The hinge is thus given good protection and ensures prolonged and reliable operation.

*Patents, *Valves, Liquids, Waste disposal, Plastics, Construction materials, Sewage disposal

Polyvinylchloride (PVC), Waste discharge, Hinges

C080
FILTRATION AND PURIFICATION OF CONTAMINATED WATER,

Schreiber, A., Schreiber, B., and Schreiber, E.

Canadian Patent 959,980. Applied March 30, 1972. Issued December 24, 1974. Patent Office Record, Vol. 102, No. 52, p 85, December 24, 1974.

A process for the filtration and purification of contaminated water by means of a trickling filter was patented. A wear-resisting filler material having a specific gravity of approximately one or below is employed. Sludge adhering to the filler material is removed by first filling the material with flushing or scavenging water, then agitating the filler material, sludge, and added water. During agitation, the greater part of the sludge is discharged, mixed with water. The flushing water is then discharged, along with any sludge it contains, after which the trickling filter may be utilized again.

*Patents, Filtration, Waste water, Purification, Trickling filters, Sludge treatment, Waste disposal

Waste discharge

C081
OPEN WATER PURIFICATION SYSTEM,

Rafael, J.

French Patent 32834V/18. Applied October 10, 1973. Issued August 2, 1974. Derwent French Patents Report, Vol. 40, No. 3, p 3, November 12, 1974.

An open water purification system was patented. The system is versatile and has a high treatment capability, such as for the cleaning up of oil slicks. Two positions are used with their internal tanks coupled by an elongated flexible plastics walled duct. The duct acts as a flocculation dwelling chamber for raw water, taken in at the bow of the first position, and mixed in the tank of that position with a flocculating agent injected into it from an on-board preparation tank. The second position contains a separation system for the precipitated sludge and an aft discharge port for the treated water.

*Water purification, *Patents, *Oil spills, Water treatment, Plastics, Tanks

C082
USE OF OXIDIZED CATIONIC STARCH IN FLOCCULATION AND DEWATERING OF MUNICIPAL SLUDGE,

Hunt, W. G., and Belz, R. J.

Anheuser-Busch, Incorporated,
St. Louis, Missouri

United States Patent 3,875,054. Applied March 4, 1974. Issued April 1, 1975. Official Gazette of the United States Patent Office, Vol. 933, No. 1, p 338, April, 1975.

A method was patented for treating raw primary sedimented sewage sludge. Its steps include the addition of from 0.016% to 0.1875% by weight (based on the dry weight of the sludge) of gelatinized oxidized cationic starch ether of amine butene halide to the raw sludge. The starch ether should have a carboxyl content equivalent to a degree of substitution of 0.0036 to 0.0108 and a degree of substitution of amine butene halide of about 0.15 to 0.25. The sludge is flocculated and then dewatered to below about 70% moisture.

*Patents, *Sewage treatment, *Sludge treatment, *Flocculation, Waste water treatment

*Starches

C083
WATER PROCESSING PLANT TO CONTROLLED ACIDITY LEVEL,

Zeidel, K. G.

U.S.S.R. Patent SU 420569. Applied March 25, 1974. Issued March 25, 1975. Derwent Soviet Patents Report, Vol. W, No. 7, p 1, March, 1975. 1 fig.

A water processing plant to control acidity level which utilizes the addition of a reagent maintaining the pH difference between treated and untreated water was patented. This water treatment plant consists of a bifurcated pipeline, in which a branch is adapted for injection of acid from a tank through its corresponding needle valve. Alkalinity and acidity of water in two branches are measured by detectors, connected to an electronic regulator and programmer. Signals are applied to a reversible regulator, acting through a servomotor on a valve. The design provides a stable value of the residual alkalinity of water in the outlet pipe.

*Acidity, *Patents, *Water treatment, *Treatment facilities, *Control, Equipment, Measurement, Pipelines, Design

*Water processing plant

C084
ELECTROLYTIC CHLORINE USED TO PURIFY DISINTEGRATED SEWAGE,

Belgian Patent 1442W/09. Applied September 30, 1974. Issued January 16, 1975. Derwent Belgian Patents Report, Vol. W, No. 9, p 2, April 8, 1975.

A patent was granted for electrolytic chlorine used to purify disintegrated sewage. Sewage containing a chloride of an alkali metal in solution is run into a first chamber. There suspended solids are broken down by a high speed disintegrator while an immersed anode and cathode subject the liquid to electrolysis evolving chlorine. The treated liquid suspension is transferred to a second chamber to be further mixed by an agitator before discharge from an outlet. Electrolysis should be continued in the second chamber. The system may be used in the purification of waste water or sewage to reduce the BOD, the COD, bacteria, and malodors to a level acceptable for discharge to rivers, canals, lakes, or the sea.

*Waste water treatment, *Patents, *Biological treatment, Suspended solids, Sewage treatment, Bacteria, Biochemical oxygen demand, Odors, Chemical oxygen demand

*Electrolytic chlorine, Sewage purification

C085
FILTER FOR PURIFICATION OF WASTE WATER,

Belgian Patent 79317V/46. Applied May 24, 1974. Issued October 16, 1974. Derwent Belgian Patents Report, Vol. 5, No. 46, p 2, October, 1974.

A filter was patented for the physical and/or biological purification of waste water. The sewage or waste water is allowed to trickle for a limited period over the filter bed, thus building up a layer of sludge and micro-organisms. Grains covering the filter bed are circulated periodically and the sludge removed. To increase the efficiency of this sludge removal process, the waste water is distributed uniformly over the whole of the filter bed by rotating distribution arms. The grains, with diameters of about 6 mm are kept in a reservoir, resting on a concrete base. Arms for washing and sludge recovery rotate around two pipes; one admits compressed air and the other evacuates sludge. The biological layer of the grains is thus aerated and the circulation of the filter grains prevents clogging.

*Waste water treatment, *Patents, *Filters, Sludge, Microorganisms, Aeration

C086
SLUDGE DEWATERING INSTALLATION,

Netherlands Patent 74332V/43. Applied April 4, 1974. Issued October 23, 1974. Derwent Netherlands Patents Report, Vol. 5, No. 45, p 3, December, 1974.

A patent was granted to a sludge dewatering installation. Straining tanks are used for dewatering industrial wastes, municipal wastes, or sewage and consist of skips with sloping sides, lined throughout with wire mesh grilling. These are supported so as to leave space for drainage to bottom outlets, from the surface of settling sludge. The skips are easily transportable by skip-lorries, to dumping or disposal sites. This eliminates manual transfer from tank to transport. The installation is economical in terms of site space required, and may be located at the sludge source.

*Patents, *Sewage treatment, *Dewatering, *Sludge treatment, Drainage

C087
PROCESS FOR DISPOSING OF AQUEOUS SEWAGE AND PRODUCING FRESH WATER,

Hess, H. V., Franz, W. F., and Cole, E. L.

Texaco, Incorporated,
New York, New York

United States Patent 3,876,538. Applied November 6, 1972. Issued April 8, 1975. Official Gazette of the United States Patent Office, Vol. 933, No. 2 p 831-832, April, 1975. 1 fig.

A process to dispose of aqueous sewage and to produce fresh water was patented. In an aqueous sewage treatment, the steps consist of: coking the sewage in the liquid phase without added free oxygen to form gases, coke, and a hot aqueous effluent containing dissolved inorganic salts; oxidizing the effluent with air to further reduce the COD and BOD; flowing the effluent to a water extraction zone; and, contacting the effluent with a hydrocarbon heated to above 500 F at a pressure sufficient to maintain at least a part of the hydrocarbon effluent mixture in the liquid phase. Thus a substantial amount of the water in the effluent dissolves in the hydrocarbon and forms a hot hydrocarbon water solution and a concentrated brine. The solution and brine are then separated and cooled to the temperature at which hydrocarbon and fresh water phases are easily separated.

*Patents, *Sewage treatment, *Potable water, Coking, Organic compounds, Effluents, Brines

Fresh water production, Hydrocarbons

C088
WASTE WATER TREATMENT SYSTEM WITH AN OZONE GENERATOR,

Koigawa, S., and Furuse, M.

Japanese Patent 49-27714. Applied March 4, 1970. Issued July 27, 1974. Japan Model Utilities. 1 fig.

A waste water treatment apparatus equipped with an ozone generator was patented. The ozone generator is enclosed within the reaction bath of the apparatus and is thus cooled effectively by the surrounding waste water. The generated ozone is collected at the top of the generator and bubbled through from the bottom of the reaction bath. Spiral fines are attached outside of the ozone generator, which increases the mixing efficiency between ozone and the waste water.

*Waste water treatment, *Ozone, *Patents, Equipment, Mixing

Ozone generator, Mixing efficiency

C089
REMOVING SOLIDS FROM SEWAGE,

U.S.S.R. Patent SU 407842. Applied July 8, 1971. Issued December 10, 1973. Soviet Inventions Illustrated, Vol. 5, No. 41, p 2, September 19, 1974. 1 fig.

A patent for a method of removing solids from sewage was issued which involves freezing with a cooling agent such as ammonia and subsequently thawing and reliquifying the ammonia. Energy consumption is reduced by liquifying the cooling agent in two stages using high and low pressure compressors in series. Ammonia is fed along a pipeline to a crystallizer/evaporator where it evaporates, drawing its heat from the sewage residues which have been poured into the vessel and frozen. Ammonia vapor passes along by the low-pressure compressor and condenses from the pressure of boiling ammonia to the pressure of intermediate condensation in the condenser/meter. Heat transfer takes place, and the previously-frozen residues melt. The high pressure compressor removes the vaporous ammonia from the condenser-melter, raising the pressure to that of the high-temperature condenser. Excess heat is transferred from the condensation temperature of the cooling agent to that in the condenser. The result is that the cooling agent liquifies and is once more conveyed by a pipeline into the crystallizer/evaporator and the cycle is repeated.

*Patents, *Sewage treatment, *Ammonia, Temperature

Solids removal, Cooling agents

C090
BIOLOGICAL PURIFICATION OF TOWN AND INDUSTRIAL EFFLUENTS,

French Patent 11432W/07. Applied April 20, 1973. Issued December 20, 1974. Derwent French Patents Report, Vol. W, No. 7, p 3, March, 1975.

A biological purification treatment method was patented which has been applied to rural, municipal, and industrial effluents. The effluent is seeded with bacterial strains, selected according to the nature of the effluent. The wastes are subjected to conditions which allow anaerobic and/or aerobic degradation of the organic matter. The effluent is coarse-screened and transferred to the primary settling tank where it is seeded with freeze-dried bacteria; corresponding natural enzymes and certain wetting agents are added. Anaerobic degradation occurs and after one to three days the effluent is collected from the upper part of the tank by passage along a pipe to an oxidation tank equipped with a projection turbine. After a period of twelve hours to twenty days, according to the degree of pollution, the effluent goes to a secondary settling tank where mineralized sludge is deposited. The treated effluent thus passes out by the overflow.

*Biological treatment, *Municipal wastes, *Industrial wastes, *Waste water treatment, Bacteria, Anaerobic treatment, Secondary treatment, Sludge treatment, Effluents

C091
IRRADIATION PLANT FOR FLUID MATERIAL, PARTICULARLY SEWAGE SLUDGE,

German Patent 12845W/08. Applied September 10, 1973. Issued February 13, 1975. Derwent German Patents Report, Vol. W, No. 8, p 2, February, 1975.

A plant for irradiating fluid material, particularly sewage sludge, was patented. Radioactive sources comprise an irradiation chamber through which the material flows. The equipment is provided with a container for a series of radiation sources, having channels for the introduction and withdrawal of these sources, which can be closed off and sealed against the fluid material. A common closure piece is provided for closing the channels and can be pressed down onto the radiation source container by a clamping retaining element. The closure piece is more reliable than individual closure elements and the radiation sources can be exchanged in a much shorter time; the danger that more than one channel is not completely sealed is considerably reduced.

*Patents, *Sewage treatment, *Irradiation, *Treatment facilities, *Sludge treatment, *Waste water treatment

C092
CONTINUOUS DETERMINATION OF TOXICITY OF EFFLUENTS,

French Patent 13200W/08. Applied May 4, 1973. Issued January 3, 1975. Derwent French Patents Report, Vol. W., No. 8, p 9, January, 1975.

The toxicity of liquids in waste water and sewage may be determined by means of microorganisms. A patent was issued whereby these are continuously cultivated in a circulation recipient with a very concentrated nutritive medium and mixed with the dilution liquid. The mixture flows continuously into a small measuring recipient which is sealed against the inflow of air and has a magnetic stirrer, then leaves via an overflow. The oxygen content of the liquid is measured continuously by an oxygen electrode. The liquid to be analyzed is saturated with oxygen in a second recipient where it is simultaneously treated with the nutrient solution. The mixture flows into the recipient then mixes with the mixture from the first chamber; and the two flow out through the overflow. Alteration in the microorganisms due to the toxicity is determined by the measurement of one of the parameters such as turbidity or color changes, which are a function of the vital activities of the organisms.

*Toxicity, *Sewage, *Waste water, *Analytical techniques, *Patents, *Microorganisms, Effluents, Liquid wastes, Measurement, Turbidity

C093
AUTOMATIC WATER SAMPLER,

Sutherland, W.

United States Patent 3,853,009. Applied October 25, 1972. Issued December 10, 1974. Official Gazette of the United States Patent Office, Vol. 929, No. 2, p 544, December, 1974. 1 fig.

A water sampler was patented for automatically collecting fluid samples from an effluent stream. It combines: a housing supportable above the stream; a sampling container with a closed bottom wall and side walls defining an open top; a supporting cable secured at one end to the sampling container; a winch mounted on the housing to which the supporting cable is wound at its opposite end; a reversible electric motor connected to the winch, with a direct current power supply; and, a pair of vertically spaced electrodes defining liquid level sensing means. One of these electrodes is adjacent to the bottom within the sampling container and the other is spaced by a gap, defining a predetermined liquid level in the container. Electric switching means are responsive to means sensing a predetermined liquid level to switch the motor in one direction for raising the sampling container towards the housing or to switch the motor in the opposite direction, lowering the sampling container.

*Patents, *Automation, *Water sampling, *Equipment, Liquids, Electric power, Electrodes, Analytical techniques, Effluents

*Water sampler, Effluent streams

C094
APPARATUS FOR THE TREATMENT AND THE CLARIFICATION OF WASTE WATER,

Teodoroiu, P. B.

United States Patent 3,850,810. Applied September 14, 1972. Issued November 26, 1974. Official Gazette of the United States Patent Office, Vol. 928, No. 4, p 1703, November, 1974. 1 fig.

A patent was granted for equipment to treat water containing solid particles in suspension. Its parts are: an outer basin centered on a vertical axis and provided with an inlet for water to be treated; a downwardly diverging open-bottomed housing centered on this axis within the basin above the inlet, being spaced so that the housing communicates with a surrounding annular space in the basin; an agitator within the chamber with a body in the form of a stepped cylinder with a larger-diameter portion and a smaller-diameter portion centered on the axis for rotation around; drive means for rotating the body causing upper vanes to exert a radially outward thrust with an upward component and lower vanes to exert a radially outward thrust with a downward component upon mixture of water with a flocculating agent, resulting in circulation and homogenization of the mixture; and, collector means in the annular space for discharging clear water from a supernatant liquid layer overlying a layer of sludge formed by the flocculation of solid particles upon the emergence of this mixture from the chamber.

*Patents, Solids, Waste water treatment, Suspended solids, Flocculation, Supernatants, Sludge

C095
APPARATUS FOR THE FILTRATION AND BIOLOGICAL PURIFICATION OF CONTAMINATED WATER,

Schreiber, A., Schreiber, E., and Schreiber, B.

United States Patent 3,846,305. Applied October 8, 1971. Issued November 5, 1974. Official Gazette of the United States Patent Office, Vol. 928, No. 1, p 266, November, 1974. 1 fig.

A trickling filter for the filtration and biological purification of contaminated water was patented. It is composed of one or more water-tight tanks containing filler material of wear-resisting material with a specific gravity of not greater than one. The tank or tanks are being provided with storage distributor devices near the top for distribution of contaminated water over the filler material. A tank having a bottom wall sloping toward a discharge chamber is provided below, into which the purified water is diverted; aeration means near the bottom of the tank aerate the filler material upward while the contaminated water trickles through the material. Any sludge or microorganisms covering the elements are cleansed. Grid means located above the bottom wall prevent filler material from discharging and further grid means in an adjacent tank prevent filler material from being removed.

*Patents, Trickling filters, Filtration, Biological treatment, Waste treatment, Waste discharge, Tanks, Aeration

Filler material, Biological purification, Contaminated water

C096
APPARATUS FOR PROVIDING A STATISTICAL COUNT OF PARTICULATE MATERIAL IN A FLUID,

Ogle, H. M.

Protron Associates,
Palo Alto, California

United States Patent 3,858,851. Applied July 5, 1973. Issued January 7, 1975. Official Gazette of the United States Patent Office, Vol. 930, No. 1, p 326, January, 1975. 1 fig.

A method of measuring particulate material in a sample volume of particulate material suspended in a liquid was patented. The liquid is contained within a sealed transparent container. A liquid inspection apparatus consists of means for: generating a well-defined beam of light; directing the well-defined light beam through the container; and, scanning the light beam over at least one path located entirely within a confined area transverse to the direction of the light beam. This sequentially illuminates particulate material in the portion of liquid from which bursts of light are scattered. Additionally, means for detecting the scattered bursts of light produce a sequence of electrical signals. Means responsive to the electrical signals occurring within a selected interval of time provide a measure of the particulate material within the sample volume.

*Patents, *Samples, Suspended solids, Analytical techniques, Liquids, Statistical analysis, Pollutant identification

Particulate material, Light beams

C097
APPARATUS FOR DETERMINING ORGANIC CARBON CONTENT OF POLLUTED LIQUIDS,

Cohen, A.

United States Patent 3,854,881. Applied September 13, 1971. Issued December 17, 1974. Official Gazette of the United States Patent Office, Vol. 929, No. 3, p 1137, December, 1974. 1 fig.

An analytical apparatus patented determines the total quantity of organic carbon as a pollutant in an aqueous stream. Using a vaporized sample, the determination is made on the basis of the measure of carbon dioxide formed per unit measure of the sample. Described is a mixing chamber and a first metering pump disposed to deliver into the mixing chamber a continuous flow sample taken from the stream. A second metering pump is disposed to deliver into the mixing chamber a continuous flow of liquid reagent for reaction with the sample, and to remove the inorganic carbon content as carbon dioxide. A continuous flow aqueous sample is analyzed in a reaction chamber, and is substantially free of inorganic carbon and carbon dioxide. An inlet introduces the aqueous sample to be analyzed and an outlet is utilized for the exit of gaseous and vapor products formed from such a sample.

*Patents, *Organic compounds, Pollutants, Pollutant identification, Streams, Liquids, Sampling, Analytical techniques, Carbon

*Organic carbon

C098
APPARATUS FOR CLEANING LOOSE FILTERING MATERIAL IN SLOW WATER FILLED WATER SUPPLY FILTERS,

Volokh, B. F.

Canadian Patent 957,288. Applied March 17, 1971. Issued November 5, 1974. Patent Office Record, Vol. 102, No. 45, p 38, November, 1974.

Equipment was patented for cleaning loose filtering material in slow water-filled water supply filters. The apparatus consists of: a washing chamber with an open bottom, placed upon the surface of a layer of filtering material to be cleaned in a water-filled filter; means for moving this washing chamber relative to the filtering layer; and washing tubes to supply clean water into the layer of filtering material to be cleaned. A suction pipe evacuates dirty water from the washing chamber. The washing tubes and suction pipe are installed within the washing chamber. Means regulate the degree of buoyancy of the washing chamber which is afloat in the filter, by regulating the pressure of the washing chamber upon the surface of the filtering material layer.

*Patents, *Filters, *Water supply, Cleaning, Equipment

Washing, Filtering material, Water supply filters

C099
DOMESTIC WATER PURIFICATION METHOD AND SYSTEM,

Zeff, J. D.

Inca-One Corporation,
Los Angeles, California

United States Patent 3,843,521. Applied August 14, 1972. Issued October 22, 1974. Official Gazette of the United States Patent Office, Vol. 927, No. 4, p 1637, October, 1974. 1 fig.

A patent was given for a household ozone generator and purification system, used for the purification of small quantities of impure water. It consists of a housing; an ozone generator mounted in the housing; means secured to the housing for energizing the ozone generator for preselected time intervals; and an open topped container with an impeller adjacent to its base. A cap for this open top defines an opening and means for mounting the housing on the cap permit ozone to flow through the cap and into a container. Thus, when the impeller is rotated, ozone is generated and flows into the container, purifying the domestic water.

*Patents, *Ozone, Water purification, Domestic water, Equipment

Ozone generator

C100
DUAL AERATION AND FILTRATION SYSTEM WITH RECYCLING,

McGee, A. L.

United States Patent 3,841,997. Applied April 2, 1973. Issued October 15, 1974. Official Gazette of the United States Patent Office, Vol. 927, No. 3, p 1141, October, 1974. 1 fig.

A method for treating liquid waste was patented. The first step consists of introducing liquid waste into the first of several separate chambers, and transferring the fluid from the first chamber to a subsequent chamber, where a lower fluid level than the previous chamber is established. Next, liquid is aerated in the chambers by intermittently passing an aerating fluid through interconnected diffusers, arranged in the lower portion of the chamber. Waste is then filtered alternately with the aerating step, by passing liquid in the chambers through the diffusers and into a subsequent one of the chambers whenever passage of the aerating fluid into the chambers is interrupted. Liquid is forced to pass because of the difference between chamber levels. Finally, treated liquid from the last one of the many chambers is discharged.

*Patents, *Liquid wastes, *Waste treatment, *Aeration, Filtration, Waste discharge, Recycling

C101
AEROBIC WASTEWATER TREATMENT SYSTEM WITH PARTIAL REUSE AND INFREQUENT DOSING TO SOIL,

Farrell, R. P., Jr.

Environment/One Corporation,
Latham, New York

United States Patent 3,844,946. Applied August 8, 1973. Issued October 29, 1974. Official Gazette of the United States Patent Office, Vol. 927, No. 5, p 2095, October, 1974. 1 fig.

A patent was issued for a waste disposal treatment system, comprised of a treatment and settling tank with an inlet for fluid waste material. There are also a first outlet for relatively dense sludge and a second outlet spaced a substantial distance above the first for removing effluent. Flow control means pass sludge through each outlet; sludge level control means actuate these flow controls to remove sludge and effluents from both tanks. Oxygen-bearing gas is selectively admitted into the treatment and settling tank for aerating and agitating the fluid waste contained there. Flocculating substances facilitate sludge formation. A digester receives sludge passing through the first outlet, and selectively returns effluent to the treatment and settling tank; on demand effluent is removed from the effluent storage tank for use as flushing water with the source of waste material or for irrigation of soils.

*Patents, *Waste disposal, *Waste treatment, Effluents, Flow control, Flocculation, Aerobic treatment, Irrigation, Storage, Sludge, Tanks, Waste water treatment

Settling tanks

C102
FLOTATION AERATOR FOR AERATING AND MOVING WATER,

Cramer, R. A., Jr.

United States Patent 3,865,909. Applied May 7, 1973. Issued February 11, 1975. Official Gazette of the United States Patent Office, Vol. 931, No. 2, p 859, February, 1975. 1 fig.

An apparatus for aerating a body of water was patented. The process consists of propelling a stream of water from the body upward and outward above its surface. A float member of substantial area serves as a support, having through it a central opening with a vertical axis. A ring member is positioned in and encases a central opening and defines a vertical water flow passage. Motor supports are spaced on the ring member. A submersible motor is carried by its supports, spaced below the float member; the motor has a power shaft axially aligned with the flow passage. A propeller and diffuser are used to impinge upon a stream of water and to disperse the water upward and outward over a wide area.

*Patents, Aeration, Flotation, Equipment, Water treatment

*Flotation aerator

C103
INCINERATOR DEVICE AND A METHOD OF PROCESSING RESIDUALS IN WASTE WATER, LIQUEFIED SEWAGE AND SLUDGE,

Bastgen, W.

Albert Klein KG,
Nieder-Fishbach, Germany

United States Patent 3,871,285. Applied February 19, 1973. Issued March 18, 1975. Official Gazette of the United States Patent Office, Vol. 932, No. 3, p 851, March, 1975. 1 fig.

A device was patented for incinerating granulated combustible material. At least one sieve-type grate feeds combustible material; the grate is in the form of a rigid plate-shaped member with spaced perforations. The peripheral outline in each perforation is small in relation to the total area of the plate-shaped area. Supply means continuously feed air to the grate from below, thereby cooling the grate. Residuals are dried preliminarily by applying pressure; the predried residuals are granulated, maintaining a bed of hot air above the grate. The granulate in the form of a layer is guided along the hot air bed, and swinging movements to the layer cause the granulate to dip intermittently into the hot air bed.

*Patents, *Incineration, Waste water treatment, Sewage treatment, Equipment

Granulation

C104
LIQUID TREATMENT PLANT AND PROCESS PARTICULARLY FOR WASTE WATER,

Chatfield, J. E.

Canadair Limited,
Montreal, Quebec,
Canada

Canadian Patent 962,386. Applied April 13, 1971. Issued February 4, 1975. Patent Office Record, Vol. 5, p 82, February, 1975.

A patent was issued for a treatment process and plant which are adaptable and can be placed within a compact package unit. The process is designed to efficiently remove phosphorus and other pollutants from waste water. In the treatment process, lime or another chemical coagulant is mixed with an influent solution to coagulate the solute and to flocculate the suspended particles in a flocculation chamber. There the mixture is raised through a field of suspended particles and reseeded with deposited particles to encourage the flocculation. The mixture is thus caused to pass through curtains of falling floc and between sedimentation trays to deposit the particles. The unit produces gravity flow serially and at predetermined individual velocities through the successive stages of the process, optimizing its flocculation and deposition conditions.

*Patents, *Phosphorus, *Waste water treatment, Treatment facilities, Pollutants, Lime, Coagulation, Flocculation

C105
PURIFICATION OF EFFLUENT CONTAINING ORGANIC MATTER,

Praznovsky, I., and Gyulavari, I.

Nikex Nehezipari Kulkereskedelmi Vallalat, Budapest, Hungary. (assignee)

United States Patent 3,819,512. Applied December 9, 1971. Issued June 25, 1974. Official Gazette of the United States Patent Office, Vol. 923, No. 4, p 1490, June, 1974. 1 fig.

Domestic or industrial effluent which contains biodegradable organic impurities is transported consecutively through an auxiliary stabilizing tank and an aerobic stabilizing tank. In the aerobic tank the effluent is subjected to oxidation by oxygen produced by photosynthesis. Some of the effluent is recycled from the aerobic stabilizing tank to the auxiliary stabilizing tank. A preferred area from which the effluent will be recycled, along with a preferred period in which effluent must be recycled are given.

*Effluent treatment, *Patents, *Organic wastes, *Water pollution, *Waste water treatment, *Water reuse, Photosynthesis

*Auxiliary stabilizing tank, *Aerobic stabilizing tank

C106
SEWAGE TREATMENT WITH HYDROGEN PEROXIDE.

Australian Patent 458,666. Applied January 6, 1972. Issued March 6, 1975. Official Journal of Patents, Trade Marks, and Designs, Vol. 45, No. 7, p 680-681, March, 1975.

A process for treating sewage and sewage systems to remove odors caused by hydrogen sulfide and to reduce corrosion caused by oxides of sulfur has been patented. It involves using hydrogen peroxide to oxidize sulfide and hydrogen sulfide and to control their regeneration or recurrence. The preconditioning treatment is to introduce hydrogen peroxide into the sewage in an amount 4-10 times the stoichiometric equivalent of sulfide and hydrogen sulfide in the influent sewage for a period of time sufficient to reduce the sulfide and hydrogen sulfide levels to essentially zero. The sulfide and hydrogen sulfide are then continuously maintained at essentially zero levels either by introducing hydrogen peroxide into the sewage in the absence of aeration in an amount 1-2 times the stoichiometric equivalent of sulfide and hydrogen sulfide into the sewage while aerating the system with air or oxygen enriched air or oxygen in an amount one-fourth to one times the stoichiometric equivalent of sulfide and hydrogen sulfide in the influent sewage.

*Waste water treatment, *Sewage treatment, *Odors, *Patents, Hydrogen sulfide, Corrosion control, Sulfides

*Hydrogen peroxide

C107
TREATING EFFLUENT,

Mono Pumps Limited,
Melbourne, Victoria, Australia

Australian Patent 459,333. Applied October 13, 1971. Issued March 29, 1975. Official Journal of Patents, Trade Marks and Designs, Vol. 45, No. 9, p 951, March, 1975.

A method was patented to treat whole raw sewage effluent. The effluent is mascerated, then passed into a vessel of submerged contact media. The media consists of a bed of randomly arranged pieces of plastic material. After the effluent is passed through the media, it is aerated. Treated effluent is then withdrawn from the vessel at a point above the bed.

*Patents, *Sewage treatment, *Plastics, Filtration, Waste water treatment, Effluents

C108
COLLECTION AND RECOVERY SYSTEM FOR OIL SPILLS,

March, F. A., and Brown, L. S.

United States Patent 3,883,433. Applied September 20, 1973. Issued May 13, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 2, p 739, May, 1975. 1 fig.

A collection and recovery system for oil spills on a body of water has been patented. The apparatus is comprised of the following parts: a basin with a flexible sheet bottom; a primary weir attached to the forward edge of the basin and supported by floatation; and, oil withdrawal means for drawing oil from the basin. The basin is supported by floatation means to maintain its rearward edge above the water line. The primary weir has weir openings for the passage of liquid from the upper layer of the body of water into the basin. The primary weir also has a plurality of separately spaced rigid modules. The flexible sheet connects adjacent modules and provides a barrier to flow between modules. Each module comprises two spaced weir floats elongated lengthwise with a weir plate fixed between the floats. The weir lip extends across the space between the weir floats. The plane of the weir plate is at an acute angle to the long dimension of the weir floats. The module floats stably with the weir plate inclined into the water, its lip being forward and higher. As the apparatus moves over the body of water, this causes a thickening of the oil ahead of the weir plate and a reduction in the pressure beneath the basin.

*Water pollution control, *Oil spills, Patents, Equipment, Water pollution sources, Oily water, Oil-water interfaces, Water pollution, Oil pollution

C109
APPARATUS FOR SEWER TREATMENT TO KILL TREE ROOTS AND OTHER ORGANIC GROWTH THEREWITHIN,

Horne, F. F.

Airrigation Engineering Company, Incorporated,
Carmel Valley,
California

United States Patent 3,880,176. Applied March 10, 1971. Issued April 29, 1975. Official Gazette of the United States Patent Office, Vol. 933, No. 5, p 2038, April, 1975. 1 fig.

Root-infested sewer pipes may be treated with a newly patented apparatus. Its parts consist of: a sled with a low center of gravity having a bottom skid for engaging only the lower portion of a pipe; means for pulling the sled through a pipe; and, upwardly facing spray means for producing a diffuse and foam-inducing spray. The sled is open at its upper end and the spray means are mounted on the sled so that they can direct spray against the upper walls of the pipe. An aqueous mixture of liquid phytocidal fumigant and surfactant is thus sprayed under pressure to the upper portions of the sewer pipe so that undesired organic growths are eliminated.

*Patents, *Sewerage, *Pipes, Organic compounds, Phytotoxicity, Liquids, Pressure

C110
PROCESS FOR TREATING WASTE WATER,

Lewandowski, S. O. R. L., and Lewandowski, R.

United States Patent 3,883,426. Applied July 16, 1973. Issued May 13, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 2, p 737, May 1975.

A process for the purification of waste water has been issued a patent. The process involves mixing waste water and aluminum in a flotation zone. The flotation zone should have an amalgam of aluminum and mercury on at least one surface. The waste water is allowed to react with the amalgam to form hydrogen gas and alumina. Impurities are carried to the surface of the waste water by the evolved hydrogen gas and alumina and removed. The purified waste water is then recovered.

*Patents, *Waste water treatment, Aluminum, Mercury, Flotation, Water purification

Alumina, Hydrogen gas

C111
SYSTEM FOR PURIFYING AND DISINFECTING WASTE WATER,

Hildebrand, K-H.

United States Patent 3,883,432. Applied September 13, 1973. Issued May 13, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 2, May, 1974. 1 fig.

A system has been patented for the continuous purification and disinfection of sewage. The system has a first mixing tank for homogenizing the sewage. This tank has a sewage inlet, a drain for solid substances which collect on the bottom of the tank and a sewage discharge leading to a feed-back line returning to the first mixing tank. A pump and a disintegrating means are arranged in this line. The first mixing tank also includes a reservoir positioned above the tank with a sewage outlet. There is a second mixing tank arranged downstream from the reservoir with a sewage inlet connected to the sewage outlet of the reservoir, a sewage outlet and at least one inlet for chemicals. The sewage outlet of the second mixing tank is connected to a closed vessel. The closed vessel is comprised of inner and outer annular chambers which are in communication with each other and with a third chamber positioned below the first and second annular chambers and provided with a sludge drain. A filter is associated with the closed vessel and arranged downstream from the upper tangential inlet of the vessel. The final part of the purification system is a disinfecting means positioned downstream from the filter.

*Waste water treatment, *Patents, *Sewage treatment, Filters, Disinfection, Facilities, Equipment, Water purification

Mixing tanks

C112
SEWAGE DISPOSAL SYSTEM,

Foster, E. P., Kelly, R. J., and Sage, W. L.

United States Patent 3,875,357. Applied November 1, 1973. Issued April 1, 1975. Official Gazette of the United States Patent Office, Vol. 933, No. 1, p 416, April, 1975. 1 fig.

A sewage disposal system has been patented which includes a liquid fuel fired steam generator, steam generating tubes, a furnace, and a passageway with a gas flow in communication with the furnace. The first step is to fire the liquid fuel within the furnace to maintain a high temperature combustion zone for the generation of steam through indirect heat exchange. The fuel input to the furnace is continuously monitored. When the fuel input exceeds a predetermined level, a pressurized liquid-solids sewage mixture is injected into the combustion zone. The sewage input mixture is steam atomized prior to being injected, continuously metered into the combustion zone, and regulated so as to maintain a sewage to fuel input ratio resulting in essentially complete vaporization and incineration of the sewage mixture.

*Patents, *Waste water treatment, *Sewage disposal, Incineration, Fuel, Waste disposal, Ultimate disposal, Sewage treatment, Municipal wastes

C113
SEWAGE TREATMENT SYSTEM,

Kovarik, V. J.

United States Patent 3,875,051. Applied March 22, 1973. Issued April 1, 1975. Official Gazette of the United States Patent Office, Vol. 933, No. 1, p 337-338, April, 1975. 1 fig.

This patented method for collecting and treating sewage consists of the following steps: collection of the sewage in several containers; storage of non-biodegradable sewage solids in each container; partial decomposition of biodegradable solids through diagenetic decomposition in each container to reduce them in size and alter their specific gravity; separation (in each container) of the liquid sewage containing suspended solids smaller than a predetermined size from floating, settled, and other solids; accumulation and temporary storage of these liquids and suspended solids between predetermined levels in each container; and, pumping the stored liquids and solids from each container as the liquid reaches the predetermined upper level. The storage of each container is used to promote a more even flow rate from a plurality of containers through collection lines interconnecting each container and the central final treatment means.

*Patents, *Waste water treatment, *Sewage treatment, *Equipment, Biodegradation, Treatment, Suspended solids, Domestic wastes, Sewage, Flow control

Collection

C114
DOMESTIC SEWAGE SYSTEM,

Arnot, N. D., Jr.

Westfield, New York

United States Patent 3,879,290. Applied May 29, 1973. Issued April 22, 1975. Official Gazette of the United States Patent Office, Vol. 933, No. 4, p 1743, April, 1975. 1 fig.

A patented sewage system which is designed primarily for domestic use consists of the following parts: two tanks of a similar size; a third tank smaller than the first two; connections between the three tanks in flow series; inlet means for sewage to enter the first tank and then flow into the second and third tanks; means for continuously aerating the sewage in the first and second tanks; means for causing essentially complete oxidation of the contents of the third tank; and timer means for actuating the oxidizing means and discharge means according to a predetermined sequence. The time sequence is in response to the filling of the third tank, allowing sufficient time for the sterilization of the contents of the third tank.

*Patents, *Waste water treatment, *Equipment, *Sewage treatment, Domestic wastes, Sterilization, Oxidation, Aeration

C115
SEWAGE TREATMENT DEVICE,

Peirish, A. J., Jr., and Uyeda, T. M.

Fountain Valley, California

United States Patent 3,878,569. Applied May 2, 1974. Issued April 22, 1975. Official Gazette of the United States Patent Office, Vol. 933, No. 4, p 1513, April, 1975. 1 fig.

A device for the treatment of sewage has been patented. It contains the following parts: a housing including a generally cylindrical section and a forward sewage inlet end; a rotable shaft coaxially mounted within the cylindrical section; a sewage macerating and conveying means mounted on the rotable shaft; an impeller mounted on the shaft; a discharge outlet on the housing; a means for rotating the shaft to cause maceration of the sewage entering through the inlet end and also to convey sewage to the impeller and out through the discharge outlet. The macerating means is comprised of a tapered auger-like element with a point facing forward, and a pair of blades with spiral-shaped leading edges converging toward the point.

*Patents, *Waste water treatment, *Sewage treatment, *Equipment, Municipal wastes, Domestic wastes

Maceration

C116
AEROBIC SEWAGE TREATMENT SYSTEM,

Yost, K. J.

Easton, Ohio

United States Patent 3,879,285. Applied December 17, 1973. Issued April 22, 1975. Official Gazette of the United States Patent Office, Vol. 933, No. 4, p 1741, April, 1975. 1 fig.

An apparatus and method for the aerobic digestion of sewage have been patented. The apparatus consists of the following parts: an essentially cylindrical treatment tank; a sewage water inlet line; a water discharge line defining an outlet within the center portion of the treatment tank; an air space above the surface of the water; an air conduit; means for directing a flow of air against the surface of the water to be treated in a manner such that circulation of the sewage in a horizontal circular path is effected; and, an air discharge passage from the air space for removing the circulated air. The sewage is treated by introducing it into the tank, supplying the air to effect the circulation of the water thereby centrifugally moving the heavier more polluted water radially outward in the tank while diffusing air into the water, and then exhausting the air.

*Patents, *Waste water treatment, *Sewage treatment, *Aerobic conditions, *Equipment, Aeration, Aerobic treatment, Domestic wastes

*Aerobic digestion

C117
METHOD FOR COMBATTING POLLUTION USING A CHROMIUM COMPLEX,

Martineau, J., and Biechler, F-J.

United States Patent 3,886,070. Applied February 16, 1972. Issued May 27, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 4, p 1593, May, 1975. 1 fig.

A method for the control of water pollution by oily products has been patented. The method involves forming a paste of the oily products, which then floats on the surface of the water and is removed by skimming. The first step of the method is the preparation of a product comprising a chromium complex anchored to solid particles of a metallic aluminosilicate. The chromium complex is coordinated to an acyclic carboxylic acid having at least seven carbon atoms, by contacting about 5-20 parts by weight of solid particles of an aluminosilicate of less than 100 micron average particle size with one part by weight of an aqueous alcoholic solution containing from about 20-30% by weight of the coordinated chromium complex. The mixture is then heated to dryness at a temperature of 100-200 C. One to four parts by weight of the dried product are distributed over one part by weight of the oily product floating on the surface of the water. The oily product then forms a paste floating on the surface of the water. The last step is to remove the paste from the surface of the water by skimming.

*Waste treatment, *Water pollution control, *Oil wastes, *Oil-water interfaces, *Patents, Separation techniques, Water pollution sources, Oil spills, Oil pollution

*Oil-water separation

C118
DETECTOR OF TRACE SUBSTANCE IN WATER,

Fujinaga, T., and Miura, K.

United States Patent 3,883,414. Applied March 27, 1973. Issued May 13, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 2, p 733-734, May, 1975. 1 fig.

A system for detecting trace amounts of impurities in water has been patented. The system comprises the following: means for supplying supporting electrolyte; first flow electrolyte cell means coupled to the supply means for purifying the supporting electrolyte; sample injector means including a sample reservoir coupled to the first cell means for injecting the contaminated sample; at least two additional flow electrolyte means including a second cell coupled to the sample injector means and a third cell coupled to the second cell; depolarizer electrolyte supply means coupled to the casing of each cell means; and, recorder coupled to the potentiostats of the additional cell means. Each of the electrolyte cells contains a casing and a potentiostat means. The casings include an auxiliary electrode. The depolarizer electrolyte flows through the casing to contact the auxiliary electrode. The recorder records the output of the potentiostats of the electrolyte cells; the output is indicative of the amount of impurities in the sample.

*Analytical techniques, *Pollutant identification, *Electrolytes, *Patents, Waste identification, Monitoring

C119
IRRADIATION PLANT FOR FLUID MATL PARTIC SEWAGE SLUDGE,

Netherlands Patent 12845W/08. Applied September 5, 1973. Issued March 7, 1975. Derwent Netherlands Patents Report, Vol. W, No. 12, p 3-4, April 29, 1975.

A patent was granted to a plant for irradiation of fluid material, particularly sewage sludge. Radioactive sources are contained in an irradiation chamber, through which the material flows. The container for a series of radiation sources has channels for the introduction and withdrawal of these sources which can be closed off and sealed against the fluid material. A common closure piece is provided for closing these channels and can be pressed down onto the radiation source container by a clamping retaining element. The closure piece insures that radiation sources can be exchanged in a much shorter time. Thus the danger that one or more channels is not completely sealed is considerably reduced.

*Patents, *Waste water treatment, *Sewage treatment, *Sludge treatment, Irradiation

C120
HORIZONTAL REACTOR FOR POLYMSN. SEWAGE OXIDATION ETC.,

Moser, F.

French Patent 87495V/51. Applied June 4, 1973. Issued January 31, 1975. Derwent French Patents Report, Vol. W, No. 12, p 2, April 29, 1975.

A patent was issued for a horizontal reactor for several chemical reactions. These include sewage water purification, sulfur dioxide absorption, and hydrocarbon halogenation. Reactions are carried out efficiently in a long horizontal vessel through which the main reaction medium, introduced at the inlet, flows. Over the whole length of the installation, separate devices are provided, positioned centrally at the bottom of the reactor. Holes are spaced closer at the start and widen in pitch progressively towards the opposite end. A second fluid medium is introduced at that point in order to set up additional currents rotating on axes parallel to the flow of the first medium.

*Patents, *Sewage treatment, *Water purification, Oxidation, Equipment

Hydrocarbons, Horizontal reactor

C121
DEVICE AND METHOD FOR CONDUCTING WASTE LIQUID FROM A RECEPTACLE TO A PNEUMATIC LIQUID DISPOSAL SYSTEM,

Svantsson, S.

Aktiebolaget Electrolux,
Stockholm, Sweden

Canadian Patent 967,843. Applied November 24, 1972. Issued May 20, 1975. Patent Office Record, Vol. 103, No. 20, p 30, May, 1975.

Equipment was patented to convey liquid from a holding receptacle to a vacuum sewage disposal system. There the waste liquid is conducted through a transport conduit. The conduit has the means to provide a suitable admixture of atmospheric air to the waste liquid being conveyed at the inlet end of the transport conduit. This gives greater efficiency in the conveyance of the liquid.

*Patents, *Equipment, *Waste treatment, Conduits, Liquids, Waste disposal, Sewage disposal

Water transport, Vacuum disposal

C122
PORTABLE WATER SUPPLY SYSTEM,

Hanford, W. E.

World Water Resources, Incorporated,
New York, New York

United States Patent 3,883,429. Applied March 25, 1974. Issued May 13, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 2, p 738, May, 1975. 1 fig.

A system to decontaminate water for potable use was patented. It consists of: a water source; a first purification tank which is connected to the source by a first conduit and at least one flexible baffle; a second purification tank connected similarly to the first purification tank; a pre-filtering means to remove particulate matter from water flowing through the first conduit; and a first recycle means which communicates between the second conduit and the first tank. The first recycle means should have a closed pressure-relief valve which will open when a pressure over 8 psi exists in the second conduit. Additionally, a first pressure filter is positioned in the second conduit, upstream of the first recycle means and a chemical addition means within the second conduit is capable of terminating the flow of water into the second tank when a predetermined height is reached. Outlets are found between the second tank and purified water distribution equipment, with a second recycle means communicating between the outlet means and the second tank, and a pressure relief valve found within the second recycle means, similar to the valve of the first recycle means. Also, a second pressure filter is positioned in the outlet means upstream of the second recycle means.

*Patents, *Potable water, *Recycling, Water treatment, Conduits, Water purification, Filtration, Tank, Pressure, Valves, Equipment, Water distribution

Pressure filtration

C123
SEWAGE AND GARBAGE DISPOSAL,

Australian Patent 458,672. Applied May 24, 1972. Issued March 6, 1975. Official Journal of Patents, Trade Marks and Designs, Vol. 45, No. 7, p 682, March 1975.

A process for the disposal of garbage, solid waste matter, sewage, or mixtures thereof has been patented. The ground garbage, ground solids waste matter and/or thickened and dewatered sewage is combined in a mixing zone with a fluidizing medium. The fluidizing medium can be a liquid hydrocarbon fuel, a liquid hydrocarbon fuel-particulate carbon slurry, a particulate carbon-water slurry, or a mixture of these. The resultant mixture is called the feed mixture and is introduced into the reaction zone of a free flow unpacked noncatalytic gas generator. The feed mixture is reacted by partial oxidation with a free-oxygen containing gas and steam under synthesis-gas producing conditions. The conditions comprise an autogenous temperature in the range of 1500 to 3000 F and a pressure in the range of one to 250 atmospheres. The result of the reaction is a hot gaseous effluent stream composed of hydrogen, carbon monoxide, carbon dioxide, water, and particulate carbon.

*Patents, *Sewage treatment, *Waste water treatment, *Waste disposal, Ultimate disposal, Incineration, Fuels, Oil, Oxidation, Domestic wastes, Oil wastes

Hydrocarbon fuels

C124
SEWAGE AND EFFLUENT TREATING SYSTEM,

Briltz, R. P.

United States Patent 3,886,073. Applied April 4, 1974. Issued May 27, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 4, p 1594, May, 1975. 1 fig.

A patent was issued for a secondary sewage treatment installation. The system functions to add a flocculating chemical to sewage, to agitate the sewage, to thoroughly mix it with the chemical, and to separate the flocculated material from the liquid effluent. An agitating module is composed of a casing which has an intake header at one end and an outlet baffle chamber at the other end of the casing. Several conduits in the casing communicate between the header and the baffle chamber, each conduit including many baffles which agitate sewage as it passes through the chamber. A horizontal perforated partition baffle spans the conduits lengthwise so that each conduit is separated into a normal flow agitation above the partition and a reverse cleaning flow below. A hinged effluent-flow-operated flap valve regulates the alternate flow directions.

*Patents, *Sewage treatment, *Effluents, *Waste water treatment, Facilities, Flocculation, Separation techniques, Conduits, Flow

Secondary treatment, Chemical treatment

C125
SEWAGE OXIDATION TREATMENT APPARATUS,

Edwards, R. N. E.

Netherlands Patent 75740V/43. Applied August 21, 1973. Issued March 4, 1975. Derwent Netherlands Patents Report, Vol. W, No. 12, p 3, April 29, 1975.

A patent was granted to a liquid sewage and waste oxidation system. The apparatus is used for chemical oxidation of contaminants having a high degree of oxygen absorption and utilization. It is composed of an enclosed vessel divided into lower and upper portions. Inlet means for receiving liquid sewage wastes define a liquid level, and outlet means for discharging the treated liquid are found in the lower portion. Means are connected to the vessel to supply oxygen to the upper portion of the vessel. An oxygen rich atmosphere results, above the liquid level. A comminutor in the upper portion directs a stream of liquid sewage from the lower portion upward, to exit into the oxygen atmosphere. At the comminutor, the liquid waste is broken into a myriad of particles, thus increasing the interfacial area between the oxygen and sewage, where oxygen may then be readily absorbed.

*Patents, *Sewage treatment, *Waste water treatment, Oxidation, Oxygen, Liquid wastes, Absorption

Waste oxidation, Chemical oxidation

C126
ACTIVATED SLUDGE SEWAGE TREATMENT FOR SEASONALLY VARIABLE THROUGHPUT,

Ostreicher, F.

Belgian Patent 16070W/10. Applied October 5, 1973. Issued February 3, 1975. Derwent Belgian Patents Report, Vol. W, No. 10, p 2, April 15, 1975.

An activated sludge sewage treatment method was patented which is applicable to treatment of seasonally variable throughput, and may be sustained in low seasons with supplementary waste matter. In this biological treatment plant, sewage is delivered into an activated sludge tank which will discharge a treated effluent. When the rate of sewage delivery is too low to sustain an adequate activated sludge level, supplementary sludge is infed from a stock tank. The tank is kept filled when there are periods of excess sludge in the activated sludge tank. The activated sludge tank may be preceded by a decantation chamber and any deficiency in sewage supply is then made up by agitation of sediment in the decantation chamber, which causes suspended sediment to be carried over to feed the sludge tank.

*Patents, *Waste water treatment, *Activated sludge, *Biological treatment, Facilities, Sewage treatment

Sludge quantity (seasonal), Stock tank

C127
SEPARATING IONISED MATERIALS FROM AQUEOUS SOLUTIONS,

German Patent 85847V/50. Applied May 23, 1973. Issued March 27, 1975.
Derwent German Patents Report, Vol. W, No. 14, p 2, March, 1975.

A patented method suitable for treating freshwater, seawater, or waste water containing heavy metals is described. Ionized materials of differing chemical or physical properties are separated from aqueous solutions containing at least 0.5 mM Mg and/or Ca and K by contact with small bubbles formed by complex-former containing living cells. Complex formers are admitted through the cell walls from a complex former absorbing solution, having an osmolarity below that of the contained cells. The osmolarity of the complex former containing solution is then increased by addition of osmolytically active materials such as Ca, K, and Na ions. Bubbles containing complex former are separated and added to an aqueous solution, until the ionizing materials migrate through the bubble membrane into the bubble. The ionizing materials are thus converted into complexes which dissolve or dissociate with difficulty. The cell bubbles are then separated from the aqueous solution.

*Patents, *Waste water treatment, *Heavy metals, Separation techniques, Ionization, Aqueous solutions

Osmolarity

C128
SEWAGE TREATMENT,

French Patent 53421U/37. Applied June 8, 1973. Issued February 7, 1975.
Derwent French Patents Report, Vol. W, No. 12, p 10, January, 1975.

A package plant for treatment of sewage was patented. The plant is divided into separate aeration, stabilization, and sedimentation chambers. A digestion cavity is positioned beneath the stabilization chamber. Raw sewage and settled sludge from the stabilization chamber are introduced into the aeration chamber. Sewage solids are converted into a liquid suspension of activated sludge flocs. These are directed to the sedimentation chamber for separation. The separated solids then pass to the stabilization chamber and purified liquid is removed from the sedimentation chamber.

*Patents, *Sewage treatment, *Aeration, Waste water treatment, Sedimentation, Separation techniques, Sludge treatment, Facilities, Activated sludge

*Package treatment plants, Waste purification

C129
SINGLE TANK SEWAGE TREATMENT PLANT,

Kaelin, J. R.

German Patent 15826U/12. Applied November 22, 1971. Issued February 27, 1975. Derwent German Patents Report, Vol. W, No. 10, February 27, 1975.

A patent was issued for a single basin sewage clarification plant. This single tank installation has a liquid turn-over device (LTD) with two openings, an upwardly directed suction opening and a downwardly directed outflow opening. One or more supply lines for the feed of an oxygen-containing gas mixture terminates in the immediate suction region of the LTD. Control devices prevent a lowering of the liquid level below the level of the suction opening. Conveyor paddles are fitted at their leading edges with cutting edges and produce shear action. The paddles have a plane running vertically to the axis of rotation of the LTD. A simple LTD of non-adjustable height is reliable, almost noiseless, and provides sufficient turn-over and oxygen supply to even the lowest liquid layer.

*Patents, *Sewage treatment, *Waste water treatment, Tanks, Facilities, Control structures

*Liquid turn-over device (LTD), Waste clarification

C130
DESALINATION OF WATER,

Australian Patent 459,735. Applied September 27, 1971. Issued April 10, 1975. Official Journal of Patents, Trade Marks and Designs, Vol. 45, No. 11, p 1172, April, 1975.

A patent was issued for a method of desalination of water. Steps include the feeding of saline water to an evaporator, the feeding of hot waste water to the evaporator, so that the waste water is in a heat exchange relationship with the saline water, the maintaining of a vacuum in the evaporator, and the extraction of condensate from a condenser. The latter is accomplished by means which extract the condensate while maintaining the vacuum in the evaporator through the condenser. The saline water boils in the evaporator and dense saline water is then extracted from the evaporator to maintain the desired level.

*Patents, *Desalination, Water treatment, Equipment, Saline water, Waste water treatment, Evaporation

C131
TREATING SEWAGE,

Australian Patent 459,688. Applied November 25, 1971. Issued April 10, 1975. Official Journal of Patents, Trade Marks and Designs, Vol. 45, No. 11, p 1161, April, 1975.

Water containing suspended solids from a sanitary system may be treated by a patented method. The steps comprise: aerating the water; delivering the water to a screen with a directional component across the screen surface and a directional component through the screen. This screen has openings which are large enough to pass the majority of suspended solids, and the screen can hold a coating of the solids on its upstream side, controlling the flow of water containing suspended solids. As a coating of suspended solids forms on the screen surface, water is continuously delivered, and solids are filtered from the water passing through the coating and the screen. The relationship between the directional components is thus controlled, maintaining the coating on the screen, while still delivering water through the screen. Water which has passed through the screen is then stored and recycled to the sanitary system.

*Patents, *Sewage treatment, *Filtration, *Waste water treatment, Suspended solids, Equipment

C132
SEWAGE TREATMENT TANK,

D'Aragon, P.

United States Patent 3,888,767. Applied September 27, 1971. Issued June 10, 1975. Official Gazette of the United States Patent Office, Vol. 935, No. 2, p 726, June, 1975. 1 fig.

A tank for the treatment of sewage was patented in which anaerobic treatment is followed by aerobic treatment. The tank is comprised of a first digester compartment with a sewage entrance which is adapted to digest solid sewage by anaerobic action, producing gases. An open bottomed lander within the first compartment is spaced inwardly from the walls to separate the sewage into solid and liquid phases, with a gas exit pipe leading from the first compartment. A conduit system conveys liquid sewage from the first compartment to the lower portion of the second compartment, where air is injected to digest liquid sewage by aerobic means. Gases are produced in the second compartment and a set of slanted trays, including inverted cups, are adapted to bubble air towards an exit pipe. From this pipe, gases are evacuated and excess air is provided, as well as an effluent discharge on the second compartment.

*Patents, *Aerobic treatment, *Anaerobic treatment, *Sewage treatment, Waste water treatment, Tanks, Equipment, Solids, Liquids, Conduits

C133
LIQUID TREATMENT APPARATUS HAVING COMBINED REACTION BASIN AND CLARIFIER,

Love, L. S.

Canadian Patent 968,031. Applied July 16, 1971. Issued May 20, 1975. Patent Office Record, Vol. 103, No. 20, p 20-81, May, 1975.

A treatment apparatus has been patented that is designed for aerating or mixing, and clarifying liquids such as industrial and sanitary waste waters and for conducting chemical reactions. The aeration or mixing basin and the clarifier are formed as one integral unit separated by a baffle. The flow from the aeration basin into the clarifier is controlled by flow control plates. The bottom of the clarifier slopes toward the aeration basin bottom, such that solids settling in the clarifier flow down the clarifier bottom towards the aeration basin. This flow causes solids to be picked up by circulation in the aeration basin and re-suspended. A sludge scraper is periodically drawn across the clarifier bottom to dislodge sludge adhering to the bottom. The clarifier surface is periodically skimmed by a skimmer to remove scum.

*Patents, *Waste water treatment, *Equipment, Clarification, Aeration, Sludge, Industrial wastes, Municipal wastes

C134
SEWAGE DISPOSAL PROCESS,

Brent, A., and Teichmann, C. F.

Canadian Patent 967,751. Applied May 17, 1972. Issued May 20, 1975. Patent Office Record, Vol. 103, No. 20, p 10-11, May, 1975.

A disposal method for sewage has been patented which involves the conversion of the sewage into synthetic gas or fuel gas by dewatering municipal sanitary sewage producing a thickened sludge. The thickened sludge is mixed with a fluid selected from a group composed of water, liquid hydrocarbon fuel, particulate carbon slurries in water or in a liquid hydrocarbon fuel which is produced subsequently in the process, and mixtures of these, to produce a feed mixture stream. The feed mixture is heated to a temperature between 212 and 600 F to vaporize volatile constituents in the feed mixture and to produce a feed dispersion stream. The feed dispersion stream is partially oxidized with an oxygen rich gas in an unpacked free-flow non-catalytic synthesis gas generator, at a temperature between 1500 and 3000 F and at a pressure between one and 250 atmospheres, to produce synthetic gas. The water separated from the sewage is purified and used for industrial purposes or else converted into by-product steam by indirect heat exchange with the product gas. This disposal method can also be used to dispose of garbage by mixing bits of garbage with the thickened sewage sludge and the fluid, forming a feed mixture which is converted into synthetic gas by partial oxidation reaction with an oxygen-rich gas in the same type of gas generator.

*Patents, *Waste water treatment, *Sewage disposal, *Dewatering, Fuel, Oxidation, Sludge treatment, Water reuse

C135
METHOD OF PURIFYING WATER,

Kennedy, S. R.

Canadian Patent 968,893. Applied February 14, 1972. Issued June 3, 1975. Patent Office Record, Vol. 103, No. 22, p 85, June, 1975.

The patented method described may be used for purifying sewage or other polluted water to render it suitable for use as drinking water. The polluted water is acidified with a mineral acid such as sulfuric, nitric, hydrochloric, or mixtures thereof. This mixture is then treated with iron to produce an iron salt in situ, then neutralized. An iron or aluminum nitrate or sulfate may be added to the mixture when it is treated with the iron.

*Patents, *Waste water treatment, *Sewage treatment, *Potable water, Neutralization, Iron, Aluminum

Acidification

C136
CONTINUOUS TREATMENT OF POLLUTED LIQUIDS,

Australian Patent 460,875. Applied December 10, 1970. Issued May 8, 1975. Official Journal of Patents, Trade Marks and Designs, Vol. 45, No. 15, p 1690, May, 1975.

A method for the continuous treatment of polluted liquids has been patented. The liquid is first subjected to a bioflocculation process in a closed space. Part of the liquid along with the formed suspension is continuously removed and allowed to sediment by gravitation in an inclined sedimentation channel. A first stream of liquid with a diluted suspension is taken from the external part of the sedimentation channel for filtering through a perfectly fluidized sludge blanket. A second stream of the suspension concentrated by gravity is passed from the internal part of the sedimentation channel back into the bioflocculation chamber. The liquid which has passed through the sludge blanket is removed for further treatment.

*Patents, *Waste water treatment, *Flocculation, Sedimentation, Sludge

*Bioflocculation, Continuous treatment

C137
WASTE WATER TREATMENT PLANT WITH BALANCED LOAD,

Kappe, S. E., and Heil, D. C.

United States Patent 3,886,065. Applied February 15, 1974. Issued May 27, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 4, p 1592, May, 1975. 1 fig.

A method of balancing the load of a waste water treatment plant has been patented. The waste water treatment plant includes an aeration tank and a clarifier tank. The method is as follows: feed waste water to the aeration tank at a flow rate that varies between a maximum and a minimum above and below a predetermined flow rate; withdraw from the clarifier tank treated waste water at the predetermined flow rate from a predetermined level in the clarifier tank positioned below the top of the clarifier tank; accumulate and store in the aeration tank and clarifier tank the waste water that flows into the aeration tank in excess of that which flows into the aeration tank at the predetermined flow rate; withdraw the waste water at the predetermined flow rate through many openings at this level; and, maintain the liquid levels in the aeration and clarifier tanks essentially equal.

*Patents, *Waste water treatment, *Organic loading, Aeration, Flow control, Flow rates

Clarification

C138
SEWAGE TREATMENT PLANT EQUIPPED WITH AN AERATION IMPELLER,

Kaelin, J. R.

Canadian Patent 968,475. Issued May 27, 1975. Patent Office Record, Vol. 103, No. 21, p 81, May, 1975.

A patent has been issued for a sewage treatment plant which is equipped with a motor driven aerator. The aerator is supported in a basin at a minimum of three points. The support mechanism for the aerator embodies at least two supports which at their ends nearest to the aerator enclose an acute angle with a horizontal plane less than 45 degrees.

*Patents, *Waste water treatment, *Treatment facilities, Sewage treatment, Equipment, Aeration, Design

Aerators

C139
WATER TREATMENT APPARATUS,

Smith, F.

United States Patent 3,881,704. Issued May 6, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 1, p 183, May, 1975. 1 fig.

An apparatus designed to be used in the treatment of water has been patented. It consists of a mixing chamber which is an upright cylindrical vessel, a minimum of three separate inlets, an outlet duct, a hydraulic ejector, and means for mixing under high shear within the vessel material introduced through the inlets. The inlets are positioned substantially uniformly around the bottom of the vessel at a distance of one half to seven eighths of the radius of the bottom of the vessel from the axis of the vessel. The inlets lead non-axially into the bottom of the vessel. The outlet duct leads away from the vessel near its top to the hydraulic ejector. The mixing means is located 0.5 to 6.9 mm from the bottom of the vessel between the inlets and the outlet.

*Patents, *Water treatment, *Equipment, *Mixing, Design

C140
MEANS FOR AND METHOD OF PURIFYING CONTAMINATED WATER,

Campbell, R. J.

United States Patent 3,885,399. Issued May 27, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 4, p 1379, May, 1975. 1 fig.

A method for purifying contaminated water by freeze crystallization has been patented. The apparatus consists of: a first stage including a first freezer-crystallizer and wash column subassembly for treating contaminated water and producing a first concentrate; a second freezer-crystallizer and wash column subassembly for treating the first concentrate and producing pure ice crystals and a second concentrate; and, means for returning part of a mixture of ice crystals and first concentrate from the second wash column to the first stage. The second freezer-crystallizer is coupled to the first wash column to receive the first concentrate and also to the second wash column to receive the second concentrate. The second wash column is coupled to the first wash column for receiving and using the first concentrate to wash the ice crystals in the second wash column and to form a mixture of the first concentrate and the ice crystals.

*Patents, *Waste water treatment, *Water treatment, Equipment, Freezing

*Freeze crystallization

C141
SEWAGE BIOLOGICAL PROCESSING,

Matskrle, S., and Matskrle, V.

Soviet Patent 415862. Issued May 20, 1975. Derwent Soviet Patents Report, Vol. W, No. 15, p 7, May, 1975.

A biological sewage treatment process was patented which operates by the formation of bio-flocs, followed by filtration separation, flotation, and recirculation. The suspension is subjected to sedimentation, and the dilute suspension flows back, returning to the process. In this example, 5 to 7 kg/cu m of activated sludge was used with sewage in the activation chambers, with a residence time of two to three hours being sufficient for purification. The separation rate was up to one mm/sec; oxidation activity was 18.5 g O2 from one cu m of air. The chamber used was divided into two similar chambers to allow the flocs to float freely and to grow. Dilute suspension flowed directly to the filters for separation and the flocs floated to a homogenizer where coagulant could be added to the suspension.

*Patents, Biological treatment, Sewage treatment, Flocculation, Separation techniques, Filtration, Activated sludge, Waste water treatment, Coagulation

C142
WASTE WATER AND SEWAGE PURIFICATION,

French Patent 22898W/14. Issued February 21, 1975. Derwent French Patents Report, Vol. W, No. 14, p 3, May, 1975.

A plant patented for waste water and sewage purification is described. The facility uses pure oxygen or air enriched with oxygen in the presence of activated sludge. A biological tank contains bacterial beds which are in the form of discs one cm thick, spaced 2.5 cm apart. A quantity of 1.5 to 2.0 kg of sludge per cu m of the tank may be maintained on the discs; of this, one kg or more is living matter. The tank is connected by an overflow to a clarifier from which the purified water overflows while sludge collects at the bottom. Water to be treated as well as some of the sludge from the base of the clarifier arrive at the inlet together. Oxygen is introduced and the oxygenated water passes into the biological tank, meeting activated sludge. Aeration takes place outside the biological tank, with a low circulation rate and a reduction in the energy requirements.

*Patents, *Waste water treatment, *Facilities, *Biological treatment, Sludge treatment, Oxygen, Activated sludge, Tanks

C143
BIOLOGICAL AND CHEMICAL PURIFICATION PLANT,

Belgian Patent 22554W/14. Issued March 3, 1975. Derwent Belgian Patents Report, Vol. W, No. 14, p 3, May, 1975.

A biological and chemical water purification plant for use in populated areas was issued a patent. The plant is constructed from uniform modular units which reduce manufacturing costs and allow for the assembly of different types of purification plants. Biological purification equipment consists of three recipients with cylindrical envelopes which are open at the top and have conical shoulders arranged tangentially. The space between two recipients, formed by an inclined wall, forms a separation space to separate the suspended floccules from the purified water. A partition forms a gas separation space in which the gas is removed from the purified water before its entry into the separation space. Aerators in the activation space are provided and are immersed to a shallow depth. Raw water enters at the center of this space and clarified water leaves via collecting pipes in the upper portion of the plant. Sludge is withdrawn through aeration grids which make the operation economical and lower the energy consumption.

*Patents, *Biological treatment, *Waste water treatment, *Water treatment, Costs, Equipment

Chemical treatment, Modular units

C144
DOMESTIC WASTE WATER AND SEWAGE EVACUATION DEVICE,

French Patent 29528W/18. Issued March 21, 1975. Derwent French Patents Report, Vol. W, No. 18, p 5, June, 1975.

An evacuation device for domestic waste water and sewage was patented, for use when the lowest point of an installation is below the level of the sewer or the septic tank. The equipment consists of a welded metal tank, which acts as a reservoir and a turbine pump driven by an electric motor with a vertical shaft. Waste water entering at the top of the tank is pumped out through a pipe; this water reaches the pump by an opening. Volute, surrounding the pump turbine, is kept filled so that the pump is continually primed and there are no starting problems. The tank and its connections all are welded and simply constructed; costs are therefore low and space requirements minimal.

*Waste water treatment, *Patents, Domestic wastes, Sewage treatment, Sewers, Pumps, Tanks, Domestic water, Waste water treatment, Costs, Equipment

Evacuation

C145
SOLIDIFICATION OF SEWAGE SLUDGE TO A HARD MATERIAL,

Belgian Patent 29090W/18. Issued April 1, 1975. Derwent Belgian Patents Report, Vol. W, No. 18, p 2, June, 1975.

A patent was granted for a method of solidifying sewage sludge into a hardened solid material. This may be accomplished with or without prior coagulation and decantation by incorporation of aluminosilicates on a dry weight basis. For example, fly ash (preferably 30 to 80%), lime (preferably 1 to 6%), earth (preferably 20-45%), and $CaSO_4$, usually as anhydrite (preferably 1.5 to 3.0%) are utilized. The final water content is optimally 15 to 30% and the final dry weight of solid sludge varies from one to 50%, preferably 4 to 20%. The fly ash may be replaced by crushed furnace slag; $CaSO_4$ may be replaced by an equimolar amount of alkaline earth metal sulphate; and cement dust, quicklime or dust from a basic oxygen furnace may substitute for the lime. Hardening in the atmosphere gives a granular or monolithic solid, which can be used as a building material. The product offers good resistance to compression, humidity, and leaching.

*Patents, *Sewage treatment, Drying, Sewage sludge, Coagulation

Aluminosilicates, Sludge solidifying, Waste reuse

C146
WASTE WATER PURIFICATION,

South African Patent 30562W/18. Issued February 5, 1975. Derwent South African Patents Report, Vol. W, No. 18, p 3, June, 1975.

A patent was granted whereby waste water is purified and the oxidized sludge may be reused for further waste treatment. This potable water clarification or waste water purification process consists of coagulation-separation, using coagulants of aluminum compounds. Wet air oxidation treatment of the sludge results from the coagulation-separation process. The pH of the sludge should be adjusted in advance so that an oxidized sludge of pH below 1.5 or above 9.0 can be obtained. The oxidized sludge may be reused for water treatment either directly or after the dissolving of the aluminum compounds by the addition of acid or alkali.

*Patents, *Waste water treatment, *Sludge treatment, Oxidation, Potable water, Separation techniques, Water reuse, Coagulation, Acidity

*Wet air oxidation, Aluminum compounds, Waste reuse

C147
PURIFYING PLANT FOR SEWAGE,

Bosje, J.

Canadian Patent 967,295. Issued May 6, 1975. Patent Office Record, Vol. 103, No. 18, p 75, May, 1975.

An activated sludge process sewage treatment plant has been patented. The plant includes an open curved tank with an elongated aerating space shaped so that its end walls are located adjacent to each other. The aerating space is divided by a partition wall which forms an inner channel portion enclosed within an outer channel portion. The channels are in series with each other, forming an endless aerating channel. Means are provided to discharge sewage into the aerating channel and to withdraw aerated sewage from the channel. A minimum of one surface aerator is provided for aerating the contents of the aerating channel. At least one sludge thickening chamber is concentrically arranged in the sludge settling chamber which is located in the inner channel portion of the aerating channel. Means are provided for returning settled sludge from the settling chamber to the aerating space, and for discharging the purified water out of the sludge settling chamber. The end walls of the aerating channel are separated to provide space for the apparatus for operating the plant and for a control chamber.

*Patents, *Waste water treatment, *Sewage treatment, *Activated sludge, Biological treatment, Aeration, Sludge treatment, Treatment facilities

C148
METHOD FOR PURIFYING WASTE WATER,

Minegishi, R.

United States Patent 3,888,751. Issued June 10, 1975. Official Gazette of the United States Patent Office, Vol. 935, No. 2, p 721, June, 1975. 1 fig.

A method of treating waste water sludge has been patented. The equipment consists of a treatment vessel with an outer container and an inner tubular member with a much smaller outer diameter than the outer chamber. This inner container extends upwardly through the outer container and contains spaced positive and negative electrical terminals at an electrical potential. Sludge waste is passed into the lower end of the inner tubular member along with a quantity of electrolyte in order to produce an electrolytic action adjacent to the terminals. This reaction causes flocculation of the sludge. Many partial sludge flows with the flocculants are directed upwardly and tangentially into the outer container. The partial flows are mixed in the outer chamber to form the flocculating materials into ball size sludge. The flocculating sludge overflows the outer container and is passed through a screen to separate the liquid from the solid flocculations. The flocculations are then collected from the screen.

*Waste water treatment, *Sludge treatment, *Patents, Treatment facilities, Flocculation, Separation techniques, Electrolytes

C149
DESALINATION,

Coogan, J. D., Hastings, D., and Toohey, C. K.

Australian Patent 460,623. Issued May 1, 1975. Official Journal of Patents, Trade Marks and Design, Vol. 45, No. 14, p 1566, May 1, 1975.

A method of desalination has been patented. Saline water is driven through each of a series of flat helical coils of tube, connected in tandem by a conduit. The direction of the water flow in each coil is from the outside towards the center. Sufficient heat is applied to the coils to form a water/steam mixture having a velocity in excess of 20 ft/sec at the center of the last coil. The water is separated from the steam, and the steam is condensed.

*Desalination, *Desalination apparatus, Condensation, Patents

Coils

C150
CENTRIFUGAL COMPRESSOR-MELTER FOR DESALINATION OF WATER,

Australian Patent 460,714. Issued May 1, 1975. Official Journal of Patents, Trade Marks and Design, Vol. 45, No. 14, p 1587, May 1, 1975.

A patent has been issued for a device to prepare potable water from brackish- or salt-water. The device consists of a precooler, an evaporator-crystallizer operatively interconnected with the precooler, an ice-brine separating vessel connected with the evaporator-crystallizer, and a compressor, melter-condenser, and auxiliary cooler. The compressor and melter-condenser are combined into a single unit formed by means of a centrifugal fluid vanes compressor. The compression chamber of the fluid vanes compressor is a melting chamber, and the fluid vanes themselves are formed from a mixture of ice particles and a fluid guided by the jets of the fluid vanes compressor rotor.

*Desalination apparatus, *Desalination, Potable water, Brackish water, Saline water, Evaporators, Patents

*Centrifugal compressor-melter

C151
SEWER BRANCH SADDLE CONNECTOR,

Clark, J. H., Burrier, C. D., and Gove, L. W., Jr.

Canadian Patent 970,792. Issued July 8, 1975. Patent Office Record, Vol. 103, No. 27, p 63, July, 1975.

A patent was issued for a connector used for the connection of a lateral or branch sewer pipe line into a main sanitary sewer pipe line at a point where there is no T or Y connector available. Called a saddle connector, the assembly consists of a cast iron saddle which will fit over a tapped hole in the main sewer pipe line. The saddle has a 360 degree circular rubber O-shaped ring sealing gasket, cemented in its retaining groove, which is located on the saddle underside. The saddle is secured to the main sewer pipe line with a stainless steel strap and bronze T bolts, using attaching washers and nuts.

*Patents, *Sewers, *Sewerage, *Pipelines, Equipment

Sewer connections, Sewer branch saddle connector

C152
SEWAGE DISPOSAL SYSTEM,

Eron, R. E.

United States Patent 3,886,068. Issued May 27, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 4, p 1592-1593, May, 1975. 1 fig.

A sewage disposal system was patented, designed for treating raw sewage. Slurrier means break up solids in the sewage into small particles; this equipment includes several withdrawal means to separate solids which are not effectively broken up by the slurrier action. Foam is also generated so that a blender may intermix additional solids with foam. Solid material of different dimensions is selectively transported to this blender means, and a drain collects output from the blender and foam. A flow control system is located so that the slurrier, blender, and foam equipment can be regulated. Sewage under treatment can thus be selectively directed to drains from its source, successively through the slurrier and foaming equipment, or, if solids are found in the sewage, it can be directed to the blender. Additionally, disposal includes an aerator whereby effluent passing from the fluid to the drains is purified.

*Waste water treatment, *Patents, *Sewage disposal, Sewage treatment, Drains, Flow control, Aeration, Equipment

Raw sewage

C153
CENTRIFUGAL PUMP FOR PROCESSING LIQUIDS CONTAINING ABRASIVE CONSTITUTENTS, MORE PARTICULARLY, A SAND PUMP OR A WASTE-WATER PUMPER,

Bunjes, J. H.

Neratoon B. V.,
The Hague, Netherlands (assignee).

United States Patent 3,881,840. Issued May 6, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 1, p 227-228, May, 1975. 1 fig.

A centrifugal pump for waste water treatment was patented, consisting of: a housing with an inlet opening and an annular delivery chamber; an impeller whose inlet eye is aligned to the inlet opening and whose peripheral portion discharges to the delivery chamber. The impeller and the housing thus define an intermediate chamber leading to the delivery chamber. Also, sealing means are formed between the openings, including opposed surface portions of the impeller. These define a sealing slot which has an outer end communicating with the intermediate chamber and an inner end connected to the inlet opening. Duct means in the impeller lead from an annular chamber to the intermediate chamber in order to redirect sediment back into the intermediate chamber.

*Patents, *Pumps, *Centrifugation, *Waste water treatment, Equipment

C154
AIR DRIVEN ROTATING BIOLOGICAL CONTACTOR APPARATUS,

Prosser, D. G.

Autotrol Corporation,
Milwaukee, Wisconsin (assignee).

United States Patent 3,886,074. Issued May 27, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 4, p 1594-1595, May, 1975. 1 fig.

The equipment for biological treatment of waste water by an air driven rotating biological contactor was patented. The apparatus consists of a treatment tank with both a fluid inlet and a fluid outlet, a circular rotating biological contactor assembly which is mounted for rotation around a horizontal axis and which can be partially submerged in the waste water in its tank. Several pockets are built along the length of the contactor and have a depth of the minor portion of the radius of the contactor assembly. A source of oxygen which contains gas under pressure and a gas conduit leading from this source into the tank are described. The conduit has submerged openings beneath the length of the contactor. Each pocket opens outwardly in a direction opposite to the direction of rotation of the assembly in order to trap gas released from the conduit.

*Waste water treatment, *Patents, *Biological treatment, Aeration, Equipment, Oxygen

C155
OXYGENATION OF WASTE WATER,

Garbo, P. W.

Canadian Patent 970,483. Issued July 1, 1975. Patent Office Record, Vol. 103, No. 26, p 82-83, July, 1975.

Sewage or other waste water may be oxygenated using a patented process. The waste water is passed through a turbulent mass of solid contact particles, together with oxygen-containing gas. Pollutant solids collide with these contact particles which may be made of coarse sand, and a fine dispersion of the oxygenating gas results throughout the liquid suspension. The contact of the dispersion of gas with the suspended and dissolved solids of the sewage or waste water causes an acceleration in the oxygenation process.

*Patents, *Waste water treatment, *Sewage treatment, *Oxygenation, Suspended solids

C156
METHOD AND APPARATUS FOR AERATION OF BIODEGRADABLE WASTE MATERIAL,

Wittrup, N. R.

Ren Vand, Incorporated,
Webster City, Iowa. (assignee)

United States Patent 3,882,017. Issued May 6, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 1, p 281-282, May, 1975. 1 fig.

A pressure aeration method for treatment of biodegradable wastes was patented. The rate of degradation is enhanced by aerobic bacteria present in the wastes by the following method: high velocity conditions are introduced and a slurry taken from the waste material is forced into a confining zone, creating a pressure greater than atmospheric and a high velocity turbulent flow; air under pressure is also introduced into this zone, providing further turbulence and an aerated slurry; the aerated slurry is withdrawn from the confining zone and placed in a mixing and separating zone, where further mixing occurs and excess air and undissolved gases are separated; and, the slurry is discharged under high velocity into a reservoir. The waste treatment apparatus consists of a means to pump the sewage material at high velocity; a riser to receive the sewage from the pump; a means for air introduction under conditions of pressure and turbulence and for aeration of sewage within the riser; and a conveying, mixing, separating, and discharging area.

*Patents, *Waste water treatment, *Aeration, *Biodegradation, Sewage treatment, Biological treatment, Separation techniques, Aerobic bacteria, Waste discharge, Pumps, Slurries

C157
BIOLOGICAL PURIFICATION OF WASTE WATER,

Australian Patent 461,079. Issued May 15, 1975. Official Journal of Patents, Trade Marks and Designs, Vol. 45, No. 16, p 1791, May, 1975.

A patent was issued for a method of biological waste water treatment. Activated sludge treatment is used in equipment consisting of common enclosure aeration and settling-clarification sections. The system is designed so that the two sections communicate with each other and aerated liquid may flow from the aeration section to the settling-clarification section. The activated sludge may also be recycled to the aeration section. Aerated liquid is directed to the bottom of a set of parallel inclined plates which cover almost the entire settling surface area of the settling-clarification section.

*Patents, *Biological treatment, *Waste water treatment, *Activated sludge, Aeration, Settling basins

Clarification

C158
SEWER LINE BLOW-OUT PLUG,

Melton, M. R.

M.M.S., Incorporated,
Memphis, Tennessee. (assignee)

United States Patent 3,895,466. Issued July 22, 1975. Official Gazette of the United States Patent Office, Vol. 936, No. 4, p 1199, July, 1975. 1 fig.

A patented plug for sewer lines is described. This plug assembly is adaptable and will seal a clean-out end of a pipe or pipe system under normal pressure conditions. However, when subjected to slight over-pressure within the pipe system, the plug will blow out, thus releasing this pressure. The assembly system consists of first and second plates for reception within the open end of a clean-out pipe and a jell-like material sandwiched between the two plates which is extrudable to engage the inferior surface of the pipe and to hold the plug within the pipe under normal conditions.

*Patents, *Pipelines, *Pipes, *Sewerage, Equipment, Pressure, Hydraulics

Sewer line blow-out plug

C159
SEWAGE TREATMENT PROCESS,

Levin, G. V., and Topol, G. J.

Canadian Patent 970,887. Issued July 8, 1975. Patent Office Record, Vol. 103, No. 27, p 84, July, 1975.

An activated sludge treatment process was patented, consisting of mixing influent sewage material with activated sludge to provide a mixed liquor. This mixed liquor is passed first to an aeration zone, where BOD is reduced and microorganisms present take up phosphate, and then to a settling zone, containing an anaerobic sludge layer. In the settling zone, the phosphate-enriched sludge settles into the anaerobic sludge layer, so that a substantially phosphate-free effluent is removed from above the sludge layer. Sludge must be maintained under the anaerobic conditions long enough for the organisms in the sludge to release phosphate to the liquid phase of the sludge. Sludge is then treated to remove the soluble phosphate from its liquid phase and is then recycled for mixing with influent sewage material.

*Patents, *Activated sludge, *Waste water treatment, *Sewage treatment, Nutrient removal, Biological treatment, Phosphates, Sludge treatment, Anaerobic conditions

C160
PROCESS FOR TREATING SEWAGE SLUDGE,

Panzer, H. P., and Dixon, K. W.

American Cyanamid Company,
Stamford, Connecticut. (assignee)

United States Patent 3,894,948. Issued July 15, 1975. Official Gazette of the United States Patent Office, Vol. 936, No. 3, p 1008, July, 1975. 1 fig.

A patent was granted for a method of sewage sludge treatment. An effective amount of a water-dispersible polyquaternary polymer is added to the sewage, comprising the reaction product of dimethylamine, a polyfunctional amine, and a difunctional epoxy compound selected from the group consisting of epihalohydrins and precursors for epihalohydrins which under alkaline conditions are readily converted into the corresponding epoxy compounds and their mixtures. The polyquaternary polymer structures are detailed, and the residues obtained from the compounds and their reactions are described. The amount of anions present is large enough to satisfy anionic requirements of the cationic portion of the polyquaternary compound and thus water is removed from the sludge.

*Patents, *Sludge treatment, *Dewatering, *Polymers, *Waste water treatment, Anions, Cations

Polyquaternary compounds

C161
DESALINATION PROCESS,

Jensen, R. E.

United States Patent 3,883,412. Issued May 13, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 2, p 733, May, 1975. 1 fig.

A method for the removal of ions (desalination) from water has been patented. A low level positive voltage is applied to a porous anode submerged in water to form a space charge layer of negative ions in and around the porous anode. A low level negative voltage is applied to a porous cathode submerged in water to form a space charge layer of positive ions in and around the porous cathode. The anode and cathode are separated from the water so as to remove the positive and negative ions from the water. The ionized water is combined with the anode and cathode. The low level positive and negative charges are removed from the porous anode and cathode respectively. Low level voltages generated by the anode and cathode are used to further deionize water.

*Desalination, *Water treatment, Desalination processes, Separation techniques, Water purification, Electrochemistry, Cathodes, Anodes

*Deionized water

C162
LIQUID TREATMENT APPARATUS,

Lindquist, H.

ITT Industries, Incorporated,
New York, New York. (assignee)

United States Patent 3,884,812. Issued May 20, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 3, p 1187, May, 1975. 1 fig.

An apparatus designed for circulating and aerating a body of water containing waste sludge has been patented. The apparatus consists of a continuous channel with a bottom and a pair of side walls. Upper and lower airfoil-shaped planes are positioned horizontally within the channel perpendicular to the walls. Each of the planes has a leading edge and a trailing edge with a chamber formed between the edges. The upper plane is positioned above the channel bottom. The lower plane is adjacent to the channel bottom. The chambers of the planes face each other. The trailing edge of the lower plane is placed in front of the trailing edge of the upper plane and below the forward edge of the upper plane. Means for introducing air immediately adjacent to the trailing edge of the lower plane are provided. The height of each plane is from one fourth to three fourths of the distance between the bottom of the channel and the top of the upper plane. Each plane is about four to twenty times as long as it is high.

*Waste water treatment, *Patents, *Treatment facilities, Aeration, Mixing, Circulation, Equipment, Sludge treatment

C163
APPARATUS FOR DISSOLVING LARGE QUANTITIES OF OXYGEN IN WATER,

Aoki, T.

Naigai Kogyo Kabushiki Kaisha,
Tokyo, Japan. (assignee)

United States Patent 3,882,205. Issued May 6, 1975. Official Gazette of the United States Patent Office, Vol. 934, No. 1, p 327, May, 1975. 1 fig.

The patented apparatus described is designed for dissolving large quantities of oxygen in water. It is composed of: an air-tight cistern; a tank on the cistern; an elongated inner vessel in the cistern with a perforated partition between it and the tank; a rotary shaft with a perforated drum, positioned perpendicularly within the tank; pipes for supplying oxygen to the drum and water to the tank; spouts which discharge water into a receiving dish on the rotary shaft; and, conduits to feed water and to control discharge of water to the dish from the spouts. Water is finely divided by the high speed rotation of the dish caused by rotation of the rotary shaft. Oxygen is released into a circular space between the outer circumference of the drum and the inner circumference of the tank through perforations, due to the centrifugal force of the drum also being rotated by the shaft. Water and oxygen mixing occurs continuously, dissolving a large volume of oxygen into the water. The water enters the inner vessel through the perforated partition and is then passed into the cistern through an opening on the vessel.

*Oxygenation, *Aeration, *Patents, *Equipment, Water treatment, Waste water treatment, Dissolved oxygen

C164
FLOCCULATING AGENTS,

Field, J. R., and Smalley, G.,

Allied Colloids Manufacturing Company, Limited,
Yorkshire, England. (assignee)

United States Patent 3,897,333. Issued July 29, 1975. Official Gazette of the United States Patent Office, Vol. 936, No. 5, p 1834, July, 1975. 1 fig.

A patent was issued for the use of a particular polymer as a flocculating agent. In the biological degradation of sludges and in the treatment of raw sewage, an organic suspension is obtained. This organic compound may be flocculated by the addition of an aqueous solution of a polymer which has an intrinsic viscosity of at least 0.5 when measured in 3 M sodium chloride. This polymer is composed of recurring units of which over 60% are of a given formula. This formula is illustrated, and is composed of a combination of hydrogen, methyl, an anion selected from the group consisting of methyl sulfate and chloride, and a nonquaternized acrylamide.

*Patents, *Polymers, *Flocculation, Sludge treatment, Sewage treatment, Waste water treatment

C165
MOBILE PURIFYING PLANT FOR WASTE WATER,

Lundqvist, B. O.

Canadian Patent 971,688. Issued July 22, 1975. Patent Office Record, Vol. 103, No. 29, p 85, July, 1975.

A portable biological purification system has been patented, which is small enough to be easily transported by highway. This waste water treatment system is within a housing and consists of provisions for biological purification, for mixing aluminum sulfate into the biologically purified water, for separating the deposited particles from the water, and for collection of these separated particles in a tank. All the equipment is located in one wall of the housing, so that a compact plant is created.

*Waste water treatment, *Facilities, Biological treatment, Water purification, Equipment, Patents

Mobile treatment system, Alum

C166
METHOD OF TREATING SEWAGE TO ENHANCE AEROBIC DECOMPOSITION,

Digney, K., and Gallauresi, A. P.

United States Patent 3,896,027. Issued July 22, 1975. Official Gazette of the United States Patent Office, Vol. 936, No. 4, p 1385, July, 1975. 1 fig.

A patented method of treating sewage to enhance aerobic decomposition was described. The method consists of four steps, these being: placing the liquid in its liquid state into a container; pumping the sewage through an impeller pump which has both inlet and outlet openings within the container; converting part of the velocity energy of the sewage which passes through the pump into pressure energy; and, mixing air into the sewage through the pump by ejecting air from an opening in one or more of the pump impeller blades.

*Aerobic conditions, *Aerobic treatment, *Patents, Waste water treatment, Sewage treatment, Liquids, Pumps

C167
BIOLOGICAL TREATMENT OF EFFLUENT WITH ROTATING DISCS,

French Patent FR 2240-190. Issued April 11, 1975. Derwent French Patents Report, Vol. W, No. 21, p 4, July, 1975.

A plant for the biological treatment of effluents using rotating discs was patented. These discs are partly immersed to provide growth support surfaces for bacteria which are alternately immersed in and withdrawn from liquid to be treated as the discs rotate. Thus, a disc carries on one or both faces one or more bundles of open-ended tubes. Discs are designed in sectors, made of polyvinyl chloride sheets set between radial, metal spokes set at less than 180 degrees to each other, bounded by a metal rim. Each sector carries a tube bundle. The plant purifies sewage or polluted effluents by an aerobic method employing contact with the discs on which bacteria are grown. Oxygenation of the bacteria is highly efficient as the disc rotates, as a result of the slight compression within the tubes as they are submerged and become filled with liquid, followed by slight under-pressure as the disc rotates and the tubes are emptied.

*Patents, *Biological treatment, *Bacteria, Waste water treatment, Equipment, Waste treatment, Aerobic treatment, Oxygenation

Rotating discs

C168
WASTE WATER PURIFICATION USING ACTIVE CARBON AND ASH,

French Patent FR 2241-502. Issued April 25, 1975. Derwent French Patents Report, Vol. W, No. 22, p 8, July, 1975.

A patent was issued for a method of waste water purification which uses activated carbon and ash obtained by pyrolysis of previously precipitated and skimmed off organic matter from processed sewage. Sludge from one settling tank is dewatered by filtration and the resulting almost dry solids are processed in a reactor. Some of the activated carbon and ash mixed with fresh water from this reactor is fed to the liquid in a second settling tank which receives the partially clarified water from the first process. After adsorption of the organic matter in this tank, sludge is pumped into a mixer in front of the first settling tank so that its adsorptive capacity may best be utilized. Because of this recycling of the waste products, disposal of less than 0.1% of the original solids is necessary.

*Patents, *Waste water treatment, *Adsorption, *Activated carbon, Recycling, Sludge treatment, Dewatering, Sewage treatment, Waste disposal

Pyrolysis, Waste reuse

C169
TERTIARY TREATMENT OF WASTE WATER WITH OZONE AND ULTRASONICS,

Belgian Patent BE-821-971. Issued May 7, 1975. Derwent Belgian Patents Report, Vol. W, No. 21, p 2, July, 1975.

A multi-stage waste water treatment was patented. The waste water is treated with a coagulating agent; treated with a polyelectrolyte flocculating agent; and passed through a laminar flow separating cell, where clarified liquid rises between closely spaced plates and the bulk of residual solid impurities settle out. The resultant clarified liquid is cavitated by ultrasonic energy, and, while in this state, is contact-treated with ozone. Two sources of ultrasonic energy should be used, one operating at a frequency of no more than 30 kHz, and the other being at least twice the frequency of the first. Ozone contact takes place in a counter-current column with the gas rising through descending clarified liquid. Thus tertiary treatment produces a very high standard of treated effluent and offers optimum economy of investment and low operating costs.

*Patents, *Ozone, *Waste water treatment, *Flocculation, *Polyelectrolyses, Operating costs, Capital costs, Tertiary treatment, Ultrasonics

Multi-stage waste water treatment

C170
FILTER FOR PURIFICATION OF WASTE WATER,

French Patent FR 2241-499. Issued April 25, 1975. Derwent French Patents Report, Vol. W, No. 22, p 7-8, July, 1975.

A filter for purification of waste water or sewage was patented. Sewage is allowed to trickle over a filter bed in order to build up a layer of sludge and microorganisms. Grains cover the filter bed and are circulated from time to time, so that the sludge is removed. Sludge removal efficiency is increased when the waste water is distributed uniformly over the whole of the filter bed by rotating distribution arms. The washing arms rotate around two pipes; one admits compressed air to aerate the biological layer and the other evacuates the treated sludge. Circulation of the filter grains prevents clogging by efficiently detaching the sludge from the grains.

*Patents, *Filters, Sewage treatment, Waste water treatment, Microorganisms, Sludge treatment, Biological treatment

*Biological filters

144

C171
OXYGEN DISSOLVING UNIT FOR AN ACTIVATED SLUDGE PLANT,

Netherlands Patent NL 7413-332. Issued May 9, 1975. Derwent Netherlands Patents Report, Vol. W., No. 21, p 1, July, 1975.

A patented oxygen dissolving unit for an activated sludge plant is described. The apparatus is contained in a tank with an inlet for incoming effluents. The unit can be installed as a package alongside a reservoir and is used to raise the biological activity and thus the efficiency of aerobic purification of the waste water. Incoming effluents may be pumped via a static mixing zone to a receiving zone beneath a gas space created by the pressurized oxygenating gas. From these, oxygen is dissolved in the static mixing zone into turbulent effluent and the de-oxygenated gas has a vent to the atmosphere. The receiving zone also has an outlet for oxygen-enriched effluent to return to the reservoir. Construction of the compact unit is inexpensive, and the directional adjustability of the outlet promotes optimum aerobic and circulatory conditions for activated sludge.

*Activated sludge, *Patents, *Waste water treatment, Reservoirs, Aerobic conditions, Oxygen, Effluents

*Oxygen dissolving unit, Package treatment

C172
SINGLE BASIN AERATED SEWAGE LAGOON WITH SPRING TIME INTENSIFIED AERATION,

Murphy, D. S.

Atara Corporation,
Montreal, Canada. (assignee)

United States Patent 3,897,334. Issued July 29, 1975. Official Gazette of the United States Patent Office, Vol. 936, No. 5, p 1834-1835, July, 1975. 1 fig.

A sewage treatment method was patented which consists of introducing raw sewage from an inlet at one end of a lagoon, passing this sewage through the lagoon in a flow path, and removing treated effluents at an outlet at the opposite end of the lagoon. Sewage is treated in a first zone of high intensity aeration by several densely disposed aerators located in rows across the flow path in the lagoon adjacent to the inlet, and is further treated in a second similar zone, where a second set of aerators are less densely disposed than the first. Sewage is then fed to a third zone of high intensity aeration with the group of aerators being more densely disposed than the second multiple; treated sewage is passed through a further zone between the third multiple of aerators and an outlet, through a zone without aerators. Thus, as sewage is passed from the first to the third multiple of aerators, the air supply to the first and second multiples of aerators is maintained and the air supply to the third set of aerators is controlled. The third group of aerators are capable of providing a zone of final high intensity aeration in the sewage being treated, and include a temperature control switch connected so that the conduits to the third multiple of aerators are closed when the temperature in the lagoon falls below about 10 C.

*Sewage treatment, *Patents, *Aerated lagoons, *Waste water treatment, *Aeration, Sewage lagoons, Temperature control, Equipment

High intensity aeration, Aerators

C173
AEROBIC/ANAEROBIC COMPOSTING DEVICE AND METHOD OF COMPOSTING,

Chester, F. B.

United States Patent 3,890,129. Issued June 17, 1975. Official Gazette of the United States Patent Office, Vol. 935, No. 3, p 1178, June, 1975. 1 fig.

A method for composting organic waste material has been patented. The organic waste material is first placed in a rotatable container which has open mesh sides. The open mesh sides of the container are covered with a removable outer cover of moisture excluding material. The container with the waste material is periodically rotated about a horizontal axis with the outer cover attached. The rotation mixes the material in the container and contacts the material with air. The periodic rotation of the container is then stopped and an inner second cover is placed over the material within the container. The inner cover directly contacts the material in the container and prevents air from freely contacting the waste. The inner and outer covers are then removed from the container. The rotation of the container (uncovered) is resumed. The continued rotation effects discharge of composted waste material from the container through the open mesh sides of the container.

*Waste water treatment, *Patents, Aerobic conditions, Anaerobic digestion, Organic compounds

*Composting

C174
WASTEWATER TREATMENT PLANT,

Torpey, W. N.

Autotrol Corporation, Milwaukee, Wisconsin. (assignee)

United States Patent 3,894,953. Issued July 15, 1975. Official Gazette of the United States Patent Office, Vol. 936, No. 3, p 1010-1011, July, 1975.

A treatment facility for treating waste water containing settleable organic solids has been patented. It consists of the following: a settling tank structure for confining the waste water at a predetermined depth; inlet means for supplying waste water to the settling tank; outlet means for removing waste water from the settling tank; and, a biological treatment unit. The settling tank structure is defined by a pair of side walls separated by an end wall at each end and a bottom wall. The tank includes many troughs extending between and communicating with the inlet and outlet means. The troughs are positioned to receive waste water from the inlet means in parallel, and to discharge waste water to the outlet means in parallel. The troughs are spaced from each other and the side walls of the settling tank and include passage means for passing the settled solids from the troughs into the settling tank beneath the troughs. Anaerobic digestion occurs in this area of the settling tank. The detention time in the settling tank is from about 2 to 4 hours. The waste water supplied to the biological treatment unit is virtually free of significant amounts of hydrogen sulfide. The biological treatment unit includes many rotatable contactors with surface areas for the growth and maintenance of aerobic biological slimes, and conduit means for supplying effluent waste water from the outlet means of the settling tank.

*Waste water treatment, *Treatment facilities, *Patents, Suspended solids, Sedimentation, Organic compounds, Settling basins, Biological treatment, Anaerobic digestion, Hydrogen sulfide

C175
METHOD AND APPARATUS FOR MONITORING AND CONTROLLING HALOGEN LEVELS IN A WATER TREATMENT SYSTEM,

De Vale, D. P.

United States Patent 3,897,798. Issued August 5, 1975. Official Gazette of the United States Patent Office, Vol. 937, No. 1, p 86, August, 1975. 1 fig.

A patented method and apparatus to monitor and control halogen levels in a water treatment system are detailed. Given that a particular halogen substance in liquid has a predetermined redox potential, a probe including a pair of capacitively coupled electrodes disposed in the liquid is used. The electrodes are periodically pulsed with a voltage pulse having a peak value slightly above the predetermined redox potential, to store a charge in the capacitance. The stored charge decays between pulses via the liquid between the electrodes at a rate determined by the content of the halogen. The charge is sensed across the electrodes by means that operate to generate a substance level indication signal. Additionally, display means respond to the substance level indication signal and provide a visual display of the substance content.

*Patents, *Water treatment, *Monitoring, *Halogens, Equipment, Electrodes

C176
WATER TREATMENT DEVICE,

Aber, H. S., Riggs, D. D., and Lamantia, J.

Water Technology Service, Incorporated,
Cleveland, Ohio. (assignee)

United States Patent 8,899,410. Issued August 12, 1975. Official Gazette of the United States Patent Office, Vol. 937, No. 2, p 628, August, 1975. 1 fig.

A modification of a water treatment device for connection to a liquid flow line has been patented. The water treatment device has a fitting with a flow path through it and is divided into separate chambers by a minimum of one electrically conductive perforated screen supported in electrically insulated relation within the flow path in the fitting. The modification consists of means located in the fitting for automatically and continuously removing accumulated deposits from the perforated screen as liquid flows through.

*Water treatment, *Patents, *Equipment, *Screens, Cleaning, Liquids, Flow

C177
AUTOMATIC SCUM REMOVAL TROUGH,

Johnson, P. R.

Harsco Corporation, Harrisburg,
Pennsylvania. (assignee)

United States Patent 3,890,289. Issued June 17, 1975. Official Gazette of the United States Patent Office, Vol. 935, No. 3, p 1222-1223, June, 1975. 1 fig.

An apparatus to remove floating scum from the surface of liquid in a tank has been patented. The apparatus is composed of a trough with side walls, support means in the tank secured to the trough, drive means, connector means secured between the drive means and the trough, means to energize the drive means, and, liquid sensor means to de-energize the drive means. The support means are adapted to permit vertical movement of an edge of one of the sidewalls of the trough. The trough is first moved in one direction by the drive means. The liquid sensor mean stops the travelling of the trough after the edge of the trough has moved a predetermined distance below the surface of the liquid in the tank. The drive means are then energized to move the trough in another direction.

*Waste water treatment, *Patents, Equipment, Scum, Water treatment, Automation

Floating scum removal

C178
PRESSURE SEWAGE SYSTEM AND MEANS,

Burkholder, J.

Robintech, Incorporated,
Fort Worth, Texas. (assignee)

United States Patent 3,897,600. Issued August 5, 1975. Official Gazette of the United States Patent Office, Vol. 937, No. 1, p 20, August, 1975. 1 fig.

A pressure sewage system which has been recently patented is described. The unit accumulates and treats gravity-fed sewage which it receives through an inlet pipe from a local source. Solids within the sewage are macerated and the resulting effluent is discharged under a pre-determined pressure into a pressurized sewer main. The unit consists of: an accumulation tank, with downwardly converging walls and a frusticonical bottom section to receive the sewage; a central sewage treatment unit, which is normally submerged below the sewage level in the tank and rests on the converging walls; a small diameter discharge pipe which extends upward from the treatment unit and connects to the pressurized sewer main; and, a pump within the treatment unit having exposed macerating blades, which are rotatable about the central axis of the frustoconical section. Thus, sewage is agitated and swirled into a vortex while the treatment unit is in operation.

*Patents, *Sewage treatment, *Sewerage, Tanks, Pipes, Equipment, Waste water treatment, Gravity

*Pressure sewage system, Gravity-fed sewage

C179
INCINERATOR FOR RAW SEWAGE,

Mainka, C. M., and Nash, G. A.

Morse Boulger, Incorporated,
Flushing, New York. (assignee)

United States Patent 3,896,745. Issued July 29, 1975. Official Gazette of the United States Patent Office, Vol. 936, No. 5, p 1647, July, 1975. 1 fig.

A patent was granted for an incinerator for the thermal disposal of raw sewage. The housing consists of: a primary combustion chamber, a secondary combustion chamber and a mixing chamber connecting the primary and secondary combustion chambers. A burner is mounted on the housing, and includes means for injecting a flame through the primary combustion chamber, toward the mixing chamber. There the flame functions to ignite waste material, producing combustion gases. Any liquid constituents of the waste material are vaporized, and an induced draft is produced in the primary combustion chamber. This causes the flow of combustion gases and vapor toward and through the mixing chamber, into the secondary combustion chamber. There the mixture is ignited for secondary combustion. A flue mounted on the housing conducts residual combustion gases from the secondary combustion chamber into the ambient atmosphere.

*Patents, *Sewage disposal, *Incineration, Waste disposal, Waste treatment

Incinerators

C180
FILTER PRESS, PARTICULARLY FOR DEWATERING SLUDGE IN SEWAGE TREATMENT PLANTS,

Bahr, A.

United States Patent 3,896,030. Issued July 22, 1975. Official Gazette of the United States Patent Office, Vol. 936, No. 4, p 1386, July, 1975. 1 fig.

A filter press was patented, useful in the dewatering of sludge from sewage treatment plants. Two endless filter belts retain the sludge between them and circulate simultaneously. These belts are held against a rotary drum and are guided around it in concentric paths. Adjustable pressure rollers hold the filter belts to the drum so that the liquids are squeezed out of the sludge. These two filter belts travel along horizontal sections situated above the rotary drum before reaching it and sludge is pretreated in these sections before it enters the area between the two filter belts around the drum.

*Patents, *Sludge treatment, *Filters, Dewatering, Sewage treatment, Equipment, Waste water treatment

*Filter belts

C181
RECOVERING PROTEINS FROM WASTE WATER,

Finley, J. W.

United States Patent 3,898,160. Issued August 5, 1975. Official Gazette of the United States Patent Office, Vol. 937, No. 1, p 202, August, 1975.

A patent was issued for a process to remove proteins and starch from effluents so that the resultant effluent would be of high enough quality for discharge into municipal waste treatment systems. In the process, a solid ferric-protein-phosphate complex would also be produced, which would be treated to recover valuable proteins which it contained. The proteinaceous waste effluents are treated by the addition of an alkali metal salt of a molecularly-dehydrated phosphate until the concentration is 0.0001 M to 0.1 M and the concentration of the source of ferric ions is 0.001 M to 0.1 M. The ferric-protein-phosphate complex is then precipitated so as to avoid precipitating the protein-phosphate complex, by raising the pH of the treated waste to 7.0. The effluent to be discharged into the municipal system is then separated from the ferric-protein-phosphate complex precipitate.

*Patents, *Water reuse, *Effluents, *Waste treatment, *Waste water disposal, Chemical precipitation, Alkalinity, Recycling

Municipal-industrial wastes, Starch, Proteins, Ferric-protein-phosphate complexes

C182
SEWAGE TREATMENT SYSTEM,

McGrath, T. F.

Lee, Meyer and Associates, Incorporated,
Westlake Village, California. (assignee)

United States Patent 3,899,423. Issued August 12, 1975. Official Gazette of the United States Patent Office, Vol. 937, No. 2, p 632-633, August, 1975. 1 fig.

A portable, small volume sewage treatment system has been patented that is modified for use in watercraft, mobile equipment and where sewage treatment facilities are not available. Means are provided for receiving, macerating and delivering sewage to a minimum of one mixing tank which is comprised of opposing vertical walls. The walls have many downwardly sloping vanes extending at a predetermined angle with respect to the vertical in alternating positions such that material falling from one vane impinges upon an alternate lower vane extending from an opposing wall. A minimum of one settling tank receives sewage from the mixing tank and permits the separation of solid sewage constituents from liquid sewage components. The settling tank also has opposing vertical walls with vanes arranged in the same manner as in the mixing tank. The solid material is finally collected in the bottom of the settling tank for periodic removal. Clarified sewage flows into a filter tank through an input filter and disinfected sewage flows from the filter tank through an output filter. Coagulant is injected into the sewage in the mixing and settling tanks; oxygen is injected into the mixing and settling tanks at a point below the alternating vanes; and bactericide is injected into the filter tank. The vanes in the mixing tank cause turbulent flow which directs heavy solids particles to the bottom of the tank for bacterial digestion, directs a cloud of flocculated sewage to the bottom of the tank, and forms pockets of oxygen beneath the vanes to provide constant contact between oxygen and the sewage.

*Waste water treatment, *Equipment, *Treatment facilities, *Patents, *Sewage treatment, Mixing, Filtration, Disinfection, Coagulation, Bactericides, Oxygen

C183
PROCESS FOR TOTAL SEWAGE TREATMENT,

Rongved, P. I.

Activox, Incorporated,
New York, N. Y. (assignee)

United States Patent 3,900,394. Issued August 19, 1975. Official Gazette of the United States Patent Office, Vol. 937, No. 3, p 951-952, August, 1975. 1 fig.

A continuous activated sludge sewage treatment process has been patented. Steps include: the introduction of a first sewage liquid into a reservoir at a speed of at least 0.8 feet per second; aeration of the sewage liquid which has been set into circulating motion; aerobic decomposition of the sewage and depletion of the oxygen content; introduction of additional sewage liquid into the oxygen-starved first sewage liquid; simultaneous denitrification of the first sewage liquid and aerobic decomposition of the second sewage liquid; and removal of the treated sewage liquid for sedimentation and clarification. The removal rate is approximately the same as the rate of injection of the raw sewage liquid. The resulting clarified liquid effluent is discharged and at least a portion of the settled sludge is returned to the liquid in the reservoir. The average retention time of the liquid in the reservoir is at least 24 hours.

*Patents, *Sewage treatment, *Activated sludge, Waste water treatment, Biological treatment, Denitrification, Aerobic treatment, Sedimentation

Clarification

C184
TREATMENT OF SEWAGE OR CONTAMINATED WATER,

Swales, D. A.

Canadian Patent 972,652. Issued August 12, 1975. Patent Office Record, Vol. 103, No. 32, p 34, August, 1975.

A patent was issued for a method for the treatment of sewage or other contaminated waters. The process consists of forming a coagulant by dissolving chrome residue or chrome ore in a strong mineral acid, such as sulfuric acid or hydrochloric acid. By using a treatment method of coagulation which employs these substances, improved cost effectiveness is achieved.

*Patents, *Sewage treatment, *Waste water treatment, *Coagulation, Costs

*Chrome, Cost effectiveness, Acids

C185
SWITCHING VALVE FOR CONTINUOUS FILTERING DEVICES,

Beuselinck, M. L.

United States Patent 3,896,029. Issued July 22, 1975. Official Gazette of the United States Patent Office, Vol. 936, No. 4, p 1385-1386, July, 1975. 1 fig.

A flow control unit has been patented which selectively controls fluid flow from a common inlet conduit through two loop-shaped flow paths into a common outlet conduit. Each loop-shaped flow path includes a filtration unit. Control is achieved by a valve which has a supply inlet port connected to the inlet conduit and two loop inlet ports arranged in an angularly spaced relation about the axis of the valve housing. Part of the valve rotates within its housing and is in continuous communication with the common inlet conduit. Thus a wall is defined, larger in angular extent than either of the loop inlet ports, so that by rotating the valve either of the ports can be exclusively used to feed the flow of liquids. Flow may be through each loop discharge port alternatively or through both together.

*Patents, *Flow, Liquids, Equipment, Valves, Filtration, Water treatment, Waste water treatment, Conduits

C186
SELF-CLEANING ROTARY FLUID FILTRATION SYSTEM,

Marsh, D. C.

Canadian Patent 972,691. Issued August 12, 1975. Patent Office Record, Vol. 103, No. 32, p 42, August, 1975.

A filtration system has been patented. Contaminated liquid is passed through a filter screen. A pressure drop causes the contaminants to adhere to the screen. Back-flow of fluid through the screen caused by a hydrodynamic or aerodynamic skid removes any contaminants from the screen. Therefore, a self-cleaning filtration system is created.

*Filtration, *Water treatment, *Waste water treatment, *Patents, Screens

C187
WASTE TREATMENT SYSTEM WITH ENCLOSED SCREEN UNIT,

Materese, V.

Canadian Patent 973,304. Issued August 26, 1975. Patent Office Record, Vol. 103, No. 34, p 1, August 26, 1975.

The patented waste treatment system described includes means for grinding solid wastes, mixing them with liquids to form a pumpable slurry and pumping the slurry to a waste treatment tank. The waste treatment tank has a screening section in which an enclosed screen unit is loosely positioned. The slurry is pumped to the interior of the screen unit and then flows outwardly through the foraminous side walls of the screen unit into a mixing section of the treatment tank. As the screened waste material is passed from the screening section of the treatment tank to the mixing section, it is mixed with chemical additives. A series of perforated baffles in the mixing section insures that the additives and screened waste material are intimately mixed and retained in the tank for a sufficient period of time to disinfect the mixture prior to its ejection from an outlet in the mixing section of the treatment tank.

*Waste treatment, *Solid wastes, Slurry, Patents, Treatment facilities, Equipment, Screens, Chemicals, Disinfection, Mixing

C188
DEVICE AND APPARATUS FOR TREATING LIQUIDS SUCH AS DRINKING WATER AND WASTE WATER,

Chapsal, P.

Canadian Patent 973,284. Issued August 19, 1975. Patent Office Record, Vol. 103, No. 33, p 82, August 19, 1975.

A device for treating potable and waste waters has been patented. It comprises a tube which is immersed in the liquid to be treated. The tube is connected at its upper end with treating gas supply means. A diffuser having radial vanes fixed to a rotating disc communicates with the lower end of the tube. A pump, positioned under and coaxial with the diffuser, pumps the liquid from the tank through passages in the disc into chambers defined by the vanes. An emulsion of the gas and liquid is formed in the chambers and then ejected into the liquid in the tank.

*Waste water treatment, *Water treatment, *Potable water, Patents, Equipment, Water purification, Pumps

C189
COUNTER-FLOW SLUDGE BURNER,

Hanway, J. E., Jr.

Canadian Patent 973,018. Issued August 19, 1975. Patent Office Record, Vol. 103, No. 33, p 26, August 19, 1975.

An incineration method for sewage sludge has been patented. The dewatered sludge is dispersed downwardly in an upwardly flowing atmosphere within a firebox where the temperature is maintained high enough to dry and burn the sludge while it is falling. The ash and other products of combustion move upwardly to a gas scrubber and ash separator; relatively clean gas is discharged to the atmosphere. The firebox is preheated by a burner at the bottom of the box. Further burning of fuel at this burner or addition to the sludge feed is performed as required to maintain the necessary temperature. Addition of fuel oil to the sludge before pumping the sludge facilitates pumping, and achieves mixing. Supplementary air is fed in somewhat tangentially at the bottom to impart rotation to the gases within the firebox.

*Sludge treatment, *Sludge disposal, *Incineration, *Combustion, Patents, Equipment, Ultimate disposal, Oil, Pumping, Temperature

C190
SEWAGE TREATMENT APPARATUS AND METHOD,

Smith, G. W.

Canadian Patent 972,088. Issued July 29, 1975. Patent Office Record, Vol. 103, No. 30, p 89, July, 1975.

A method and its related equipment were patented for use in the activated sludge treatment of sewage. Raw sewage is mixed with return (activated) sludge and the mixed sewage liquor is then confined in a tank and aerated. There may also be additional sub-surface aeration. Air is circulated through the sewage in a predetermined vertical flow pattern through several flow passageways within the tank. After the required amount of time, the treated sewage liquids are removed from the tank; sludge is removed for recycle or ultimate disposal; and effluent water may be clarified.

*Patents, *Activated sludge, *Waste water treatment, *Biological treatment, Sewage treatment, Effluents, Sludge disposal, Aeration, Waste disposal

C191
AERATION METHOD AND APPARATUS,

Di Gregorio, D., and Shell, G. L.

Envirotech Corporation,
Salt Lake City, Utah.

Canadian Patent 972,878. Issued August 12, 1975. Patent Office Record, Vol. 103, No. 32, p 84, August, 1975.

A submerged aerator was patented and includes a non-impelling bubble shearing mechanism which rotates with and below an axial flow impeller. This impeller forces liquid down past the bubble shearing mechanism and entrains these bubbles in the downward flow. Increased retention of the sheared bubbles in the lower portion of the liquid body thus results. The shearing mechanism is composed of: a hollow cylinder (with an open bottom to receive bubbles); a closed top concentrically secured to a rotating shaft; and a slotted sidewall through which the bubbles are released and sheared.

*Patents, *Equipment, *Aeration, Waste water treatment

*Aerators, Shearing mechanism

C192
CLOSED-LOOP OZONE GENERATING AND CONTACTING SYSTEM,

Lee, H., and Rosen, H. M.

W. R. Grace and Company,
New York, N. Y. (assignee)

Canadian Patent 973,285. Issued August 19, 1975. Patent Office Record, Vol. 103, No. 33, p 82, August, 1975.

A system has been patented by which water can be treated with ozone and/or oxygen in a closed-loop cycle. This conserves the high oxygen content gas. A pressure-swing fractionator has the dual functions of producing the necessary oxygen enriched gas for subsequent use and maintaining a low nitrogen level throughout the closed loop. This fractionator removes nitrogen, carbon dioxide, and water vapor from a feed gas to produce an oxygen enriched gas, which then flows to a contactor or an ozonator. The oxygen enriched gas from the ozonator contains from about one to seven percent ozone. This gas mixture is then contacted with water to be treated. Purified water is recovered, and excess oxygen rich gas (now at least partially depleted in ozone and/or oxygen and enriched in nitrogen) forms a recycle gas which is combined with a charge of air and flowed to the pressure-swing fractionator to begin another cycle.

*Patents, *Ozone, *Oxygen, Nitrogen, Carbon dioxide, Water treatment, Recycling, Water purification

Pressure swing fractionator

C193
SEWAGE FLOCCULATING AND SEDIMENTATION TANK UNIT,

Dunkers, K. R., and Johansson, J. H.

Canadian Patent 972,880. Issued August 12, 1975. Patent Office Record, Vol. 103, No. 32, p 85, August, 1975.

A highly efficient tank for the treatment of sewage has been patented. The unit is a combined sewage flocculating and sedimentation process. Flow of sewage is described, such that when seen in a plate view, the sewage is directed substantially perpendicular to the longitudinal direction of the tank. When viewed from a vertical section, flow is obliquely upward. Connections between the flocculating portion and the sedimentation portion are such that sewage flows through the tank and then to an outlet within the sedimentation portion.

*Sewage treatment, *Tanks, *Patents, *Flocculation, Waste water treatment, Sedimentation, Flow

C194
METHOD OF AND APPARATUS FOR FILTERING,

Hirs, G.

Hydromation Filter Company,
Livonia, Michigan. (assignee)

United States Patent 3,900,395. Issued August 19, 1975. Official Gazette of the United States Patent Office, Vol. 937, No. 3, p 952, August, 1975. 1 fig.

A new filter device was patented for the removal of solids from liquid. The filter media bed is composed of anthracite coal, characterized by primary filter granules and smaller, fine, flaky particles. The bed has upper inlet and lower outlet surfaces; the smaller particles tend to accumulate at the inlet surface after backwashing and thus inhibit penetration into the anthracite bed by particulate contaminants. Positioned on the inlet surface of the bed are black walnut shells. These should be selected of a size and shape in relation to the fine anthracite particles in order to intermix with them after backwashing. The walnut shells have an angular, three-dimensional configuration to inhibit binding off the bed of anthracite coal by fine particles and accumulated contaminants. In the inlet surface of the filter media bed, a portion of the black walnut shells are intermixed with the smaller fine particles and provide a more effective penetration of the inlet surface by contaminants, thus improving the filter capabilities of the bed.

*Patents, *Filters, *Waste water treatment, Separation techniques

Filter bed media, Black walnut shells, Anthracite coal, Solids removal

C195
PROCESS FOR TREATING WASTE WATER EFFLUENT HAVING ODOURS,

Tsutsumishita, K., Yokoyama, Y., and Egawa, T.

Daikyo Oil Company, Limited,
Tokyo, Japan. (assignee)

United States Patent 3,903,250. Issued September 2, 1975. Official Gazette of the United States Patent Office, Vol. 938, No. 1, p 333, September, 1975.

A patent was issued for a treatment method for waste water containing hydrogen sulfide, mercaptanes, or other sulfur compounds, in order to eliminate undesirable odors. The pH of the waste water should be adjusted to 6 to 7 with a mineral acid or alkali; the waste water effluents may then be contacted with a hydrocarbon oil. The oil must have an average molecular weight of 100 to 300, and the mixing ratio of the hydrocarbon oil to the waste water effluent should be ten to one:one by volume.

*Patents, *Waste water treatment, *Effluents, Hydrogen ion concentration, Odor, Hydrogen sulfide

Hydrocarbons

C196
WET OXIDATION DISPOSAL OF WASTE MATTER IN SUSPENSION,

French Patent FR 2244-722. Issued May 23, 1975. Derwent French Patents Abstracts, Vol. W, No. 26, p D4, August, 1975.

A reactor for wet oxidation disposal of waste matter in suspension has been patented. The reactor is essentially a horizontal, cylindrical autoclave, divided into several compartments by vertical partitions. An inlet line delivers liquid into the first of these compartments. Each compartment contains a top entry, high speed rotary shaft, with two vertically spaced agitators, and a bottom entry oxygen/air inlet nozzle. The nozzle is directed onto the underside of the lower agitator and disperses fine bubbles into the liquid. Transfer pipes aid in moving the liquid between compartments and in discharging it from the final chamber via separate vapor and liquid outlets. In the disposal of waste organic matter, BOD and COD values are reduced by 80 to 90%. Because of the intense dispersal of fine oxygenation bubbles, the process performs well at lower temperatures than previous wet oxidation processes.

*Waste disposal, *Oxidation, Waste water treatment, Organic matter, Biochemical oxygen demand, Chemical oxygen demand

C197
SEWAGE AERATION TURBINE,

South African Patent ZA 7305-730. Issued February 21, 1975. Derwent French Patents Abstracts, Vol. W, No. 22, p D1, July, 1975.

A sewage aeration turbine has been patented. The device consists of an axial flow impeller, designed to rotate below the surface of a liquid body; and a drive mechanism coupled to the impeller to rotate it. The impeller includes several radially extending propeller blades. At least some of these are hollow and have one or more openings which permit the passage of gas into the liquid from the interior of the hollow blades. Equipment located above the liquid surface communicates with the interior of the hollow blades to deliver the gas. Thus, the gas flows out the openings in the blades as the blades rotate to impel the liquid.

*Patents, *Aeration, *Sewage treatment, *Equipment, Waste water treatment

Aeration turbine

C198
POLLUTED WASTE WATER PURIFICATION,

Soviet Patent SU 437719. Issued January 3, 1975. Soviet Inventions Illustrated, Vol. W, No. 24, p D1-D2, July 22, 1975.

A patent was issued for a method of waste water purification in which only the most contaminated part of the effluent is treated. Surface waste water from populated and industrial areas was collected. The water received during the first 20 to 30 minutes (the most heavily contaminated) was separated for biological treatment with municipal sewage in an aeration tank. The remaining water was aerated in a periodically emptied tank. In one case, the initial amount of waste water was allowed to settle before being mixed with municipal water for biological purification. The remaining collected surface waste water was aerated in the presence of activator or treated waste water from the first portion. Following disinfection, the water could be reused for industrial or domestic purposes.

*Patents, *Waste water treatment, *Biological treatment, *Sewage treatment, Aeration, Tanks, Reservoirs, Water reuse

Municipal-industrial wastes

C199
PROCESS AND APPARATUS FOR TREATING WASTES BY A COMBINED ACTIVATED SLUDGE AND BIOLOGICAL FILTER BED,

Tymoszczuk, J.

Canadian Patent 972,877. Issued August 12, 1975. Patent Office Record, Vol. 103, No. 32, p 84, August, 1975.

A patent has been granted to a process and equipment for treating wastes by a combined activated sludge and biological filter bed. Sewage is treated in a tank containing the means to maintain a submerged biological filter bed zone containing finely divided, particulate filter media. The tank further contains equipment to maintain an activated sludge zone in the tank in an upstream fluid flow relationship to the submerged biological filter bed zone. Baffles divide the tank into several compartments. These baffles extend through the activated sludge zone and partially into the biological filter bed zone. When the apparatus is in use, the finely divided particulate filter media can be recirculated and backwashed and the activated sludge zone aerated. Sewage is fed into the first compartment and treated effluent is removed from the activated sludge zone of the last compartment.

*Patents, *Activated sludge, Filters, Waste water treatment, Sewage treatment, Biological treatment, Equipment

Biological filters

C200
CONTINUOUS FILTRATION APPARATUS FOR SEWAGE,

French Patent FR 2247-270. Issued June 13, 1975. Derwent French Patents Abstracts, Vol. W, No. 29, p D2-D3, August, 1975.

A cylindrical filter tank, covered with a filtering fabric, is arranged in a reservoir. In this patented method, sewage enters the chamber of the reservoir through an inlet pipe. A cylindrical supporting plate surrounds the filtration tank, and another cylindrical support plate is arranged inside the chamber. Sewage water flows up the passage and through the filter into the space. Air enters through openings and generates a flow of bubbles; this produces a pressure difference between the fluid containing bubbles and the fluid without bubbles. The pressure difference removes the solid matter adhering to the filtering fabric and prevents clogging. An overflow pipe then receives the filtered water. Any small particles which pass through the filter are evacuated from the conical portion by an air pump. Concentrated solid matter and residue from the sewage is evacuated for further treatment. Because the flow of bubbles prevents any blocking of the filter fabric, removal of the suspended solid matter is efficient and continuous filtration is possible.

*Patents, Filtration, Sewage treatment, Tanks, Waste water treatment, Pumps, Equipment, Filters, Separation techniques

Continuous filtration

C201
WASTE WATER AND SEWAGE PURIFICATION APPARATUS,

Belgian Patent BE 825-764. Issued June 16, 1975. Derwent Belgian Patents Report, Vol. W, No. 28, p D3, August, 1975.

An apparatus for treating waste water and sewage which can be installed inside an aeration tank was patented. It operates either by the activated sludge process or by chemical purification with air or an oxidizing gas. A flat supporting surface carries the air feeding device and a discharge gutter. The latter is parallel or vertical with respect to the support, depending upon whether the shape of the tank is rectangular or cylindrical. The air feed consists of an extensible tube provided with porous aerators. Air is received which sufficiently aerates the contents of an activation zone and recycles any settled sludge out of a reclarification zone. At the same time, floating sludge is evacuated from the surface of the latter zone. The gutter has a terminal oblique plate, which is swept by the air leaving the inlet device so that a suction effect is created to draw the floating sludge from the reclarification zone to the activation zone. This equipment is particularly suitable for small sewage treatment plants with tanks made of metal, plastic, asbestos cement, or concrete.

*Patents, *Sewage treatment, *Waste water treatment, Activated sludge, Biological treatment, Aeration, Sedimentation

Chemical treatment

C202
METHOD FOR THE PURIFICATION OF WATER,

Lindquist, N.

Canadian Patent 972,484. Issued August 5, 1975. Patent Office Record, Vol. 103, No. 31, p 85, August, 1975.

A method has been patented for the purification of sludge-free sewage which contains biodegradable organic material and phosphorus compounds. Sewage is passed through an oxygen-containing gas, and through a permeable bed which contains at least one metal of the group consisting of iron and aluminum. The flow of the oxygen-containing gas is then adjusted, as is the thickness of the bed, so that biological microorganisms capable of decomposing the organic material in the sewage are formed in at least one portion of the bed. At the same time, at least one metal is dissolved from the bed in a large enough quantity to flocculate most of the phosphorus compounds in the sewage. The permeability of the bed must be such that the formed phosphorus-containing flocs, together with the formed biological flocs, are able to pass through the bed and the sewage is then separated from these flocs.

*Patents, *Sewage treatment, *Flocculation, *Nutrient removal, Biological treatment, Waste water treatment, Oxygen, Microorganisms, Organic matter, Biodegradation, Iron, Aluminum, Separation techniques

C203
SEPTIC TANKS,

Carlson, A. L., and Pinezich, J. R.

Andrew Carlson and Sons, Incorporated,
Kings Park, New York. (assignee)

United States Patent 3,898,162. Issued August 5, 1975. Official Gazette of the United States Patent Office, Vol. 937, No. 1, p 202-203, August, 1975. 1 fig.

A patent has been issued for a method of sewage disposal. The system consists of a leaching pool having a wall with effluent slots and a frusto-conical dome atop the wall which forms the top and sides of a concave-convex bowl-shaped septic tank. This tank is located below the level of the top of the leaching pool wall and has a peripheral flange held by the leaching pool wall top and the dome. The flange supports the septic tank in the upper part of the pool, and the septic tank extends only part of the way down into the leaching pool and is provided with an inspection opening in its bottom. The inspection opening is held closed and sealed by the weight of sewage in the tank. Included in the system are a baffled inlet in one side of the dome and a tubular outlet partly within the dome and partly within the septic tank for the discharge of treated sewage into an outlet pool between the tank and the pool wall.

*Patents, *Sewage disposal, *Waste disposal, *Septic tanks, Equipment

C204
TREATING SEWAGE,

Australian Patent 461,647. Issued June 5, 1975. Official Journal of Patents, Trade Marks and Designs, Vol. 45, No. 19, p 2112, June, 1975.

A method was patented for the removal of solids from liquid sewage. A tank is described, with a floor which ends in an accumulation zone for solids, parallel to and adjacent to a first side wall. Sewage is passed into the tank, and uniformly distributed along the first side wall which is positioned transverse to the direction of flow. Air is introduced into the sewage adjacent to the first side wall and above the accumulation zone. Thus, liquid containing light organic matter and light particles of grit of a specific gravity greater than the organic matter is forced to flow upward toward a second side wall, opposite the first wall. The wall interrupts the flow and directs it downward to the tank floor by a baffle positioned adjacent to the second wall. At least part of the sewage is passed under the baffle and upward between the baffle and the second side wall where it is removed by flow over a weir which extends the full length of the second side wall.

*Patents, *Sewage treatment, *Separation techniques, *Equipment, Waste water treatment, Aeration, Organic matter, Tanks

C205
HIGH ENERGY ELECTRON TREATMENT OF WATER,

Trump, J. G.

High Voltage Engineering Corporation,
Burlington, Massachusetts. (assignee)

United States Patent 3,901,807. Issued August 26, 1975. Official Gazette of the United States Patent Office, Vol. 937, No. 4, p 1424, August, 1975. 1 fig.

A patent was issued for a method and related equipment for sludge thickening followed by the electron treatment of water. A machine source of a continuous beam of electrons is described; electrons of a given energy penetrate the water-borne sludge in a metal enclosed region at a rate sufficient to decrease the average density of the sludge by a factor of at least two. The percentage of the total COD of the water and sludge are increased by a supply of oxygen. Within a constricted region, with a cross section perpendicular to the direction of water flow, means for injecting the high energy electrons are located. The electrons are thus injected into gas-containing water and the radiation effect of the electrons is optimized by the presence of a quantity of oxygen.

*Patents, *Waste water treatment, Sludge treatment, Oxygen, Radiation, Equipment

Sludge thickening, Electrons

C206
METHOD AND APPARATUS FOR PURIFYING WASTE WATERS AND SEPARATING SLUDGE,

Stopka, K.

Canadian Patent 973,830. Issued September 2, 1975. Patent Office Record, Vol. 103, No. 35, p 39, September, 1975.

A patent was issued for the treatment of waste water and the separation of sludge. The effluent liquid is formed into droplets in an ozone containing atmosphere. Suspended material in the water is removed by electrolyzing the water. Hydrogen gas bubbles are thereby produced, which rise to the surface of the water, carrying the suspended material to form floating sludge. The sludge is removed, leaving clarified water.

*Patents, *Waste water treatment, *Separation techniques, Sludge treatment, Effluents, Ozone

C207
QUICK RELEASE SAFETY TRAP,

McIlroy, J. C.

United States Patent 3,908,208. Issued September 30, 1975. Official Gazette of the United States Patent Office, Vol. 938, No. 5, p 2010, September, 1975. 1 fig.

A quick release trap for connecting waste water return plumbing lines has been patented. An arcuately curved pipe bend portion is described, having a pair of upwardly opening leg portions, sized to receive a corresponding one of a pair of downwardly pointed pipes. Each leg portion has several segmented and frangible end portions. Each respective leg portion is attached to its opposed pipe by a pair of engageable clamps. A threaded fastener is used to tighten each clamp and secure the tight attachment. The bend portion and leg portions are constructed of a high density polyethylene substance; light is therefore admitted through their walls so that a visual inspection of the condition of the pipe bend is possible before removal for cleaning. Each leg portion is readily detachable from its opposed pipe, and a water hose or other cleaning instrument may be inserted to remove or dislodge clogging material from the bend portion.

*Waste water treatment, *Patents, *Pipes, *Construction materials, Plastic pipes, Equipment

C208
WASTE TREATMENT APPARATUS,

Rosenberg, L. R.

United States Patent 3,904,525. Issued September 9, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 2, p 768, September, 1975. 1 fig.

A patent for a biological reactor for waste treatment has been issued. Biological mass growing media is attached to the rotor of a rotating biological reactor. The media consist of a group of wedge-shaped elements, each having opposite planar major surfaces. Each of these surfaces has a pattern of protrusions and depressions, and include coacting projections and receptacles which serve as spacers to keep the elements apart from one another. Alignment means includes pockets in each of the elements and latches whereby pockets of one element align and cooperate for engagement with latches in an adjacent element.

*Patents, *Biological treatment, *Waste water treatment, Equipment, Microorganisms

Media

C209
SEWER LAYING SYSTEM,

Brown, W. R.

United States Patent 3,906,737. Issued September 23, 1975. Official Gazette of the United States Patent Office, Vol. 928, No. 4, p 1529, September, 1975. 1 fig.

A tile setting piece of machinery has been patented for the laying of sewers. The apparatus consists of: a chassis trestle including parallel base rails; a pair of top rails on pillars in alignment with and above the base rails; and transverse beams connecting the respective terminal ends of both the top and base rails. A tile-bed laying car is mounted between the top rails on trolleys. One of the trolleys moves the car along the top rail. The car has side walls and end walls which form an enclosure, open at the top and bottom to collect and pass a predetermined layer of aggregate material. The car also has a tile setting bumper projecting to the rear of the car and a push ring to engage the bell flange of a tile. A cover fill car is mounted behind the bed laying car within the trestle on the trolleys. The cover fill car is also moved along the top rails, and has side and end walls, so that a predetermined layer of cover material may be released over the installed tiles.

*Sewers, *Sewerage, *Patents, Equipment, Installation, Tiles, Tile drains

C210
WASTE WATER TREATMENT PROCESS,

Hutton, D. G., and Robertaccio, F. L.

E. I. Du Pont de Nemours and Company,
Wilmington, Delaware. (assignee)

United States Patent 3,904,518. Issued September 9, 1975. Official Gazette of the United States Patent Office, Vol. 938, No. 2, p 766, September, 1975. 1 fig.

A patent was issued for a process of continuous waste water purification to reduce its biochemical oxygen demand, chemical oxygen demand, and total organic carbon. The system consists of a zone where the waste water is contacted. The waste water should have a pH of between 4 and 11, and may have already been treated for solids removal. It is combined with biologically active solids in a sufficient amount to produce a total suspended solids content of the mixture of 10 to 50,000 ppm. The mixture is then aerated by mixing it with a gas containing molecular oxygen for at least two hours. The effluent is then removed from the treatment zone; solids are separated from the purified water, and about 50 to 1500 parts of activated carbon per million parts of feed waste water are added. The carbon must have a surface area of at least 100 sq m per gram and particles of a size that will pass through a 200 mesh per inch sieve.

*Patents, *Waste water treatment, *Suspended solids, Biochemical oxygen demand, Chemical oxygen demand, Biological treatment, Activated carbon

C211
APPARATUS AND METHOD FOR PRODUCING AIR BUBBLES IN A BODY OF LIQUID,

Canadian Patent 974,671. Issued September 16, 1975. The Patent Office Record, Vol. 103, No. 37, p 72, September, 1975.

An apparatus and method for producing air bubbles in a body of liquid have been patented. The effectiveness of air barriers in restraining surface water pollutants is achieved by equalizing the air pressure in a perforated bubbling hose. An auxiliary distributing conductor carrying high pressured air and interconnected at intervals with the bubbling hose is utilized.

*Water pollution control, *Patents, *Bubbles, Equipment, Oil spills

Surface water pollutants

C212
RECOVERY SYSTEM FOR OXYGEN FROM WASTE WATER OXYGENATION,

Lange, K. W., and Maher, J. B.

Chicago Bridge and Iron Company,
Oak Brook, Illinois. (assignee)

United States Patent 3,909,409. Issued September 30, 1975. Official Gazette of the United States Patent Office, Vol. 938, No. 5, p 2396, September, 1975. 1 fig.

A system for the recovery of oxygen from the oxygenation of waste water has been issued a patent. Substantially pure gaseous oxygen is introduced through waste water with a high biochemical oxygen demand (BOD). An effluent stream of gas containing oxygen mixed with nitrogen, carbon dioxide, water vapor, and other gases present in trace quantities is separated from the oxygenated waste water. The effluent stream of gas is fed into a pool of liquid oxygen. This solidifies the carbon dioxide and converts the water vapor to ice. A gas stream containing oxygen, nitrogen, and trace quantities of other gases is separated from the liquid oxygen. The gas stream is then cooled to a temperature sufficiently low to condense only the oxygen in the nitrogen. The condensed and liquified oxygen is separated from the nitrogen gas, and returned to the pool of liquid oxygen. Liquid oxygen is vaporized from the pool and used to treat additional waste water.

*Waste water treatment, *Patents, *Oxygen, Biochemical oxygen demand, Gases, Carbon dioxide, Recycling

Oxygen recovery

C213
METHOD FOR PROCESSING SLUDGE,

Ohuchi, M., Kitahori, T., Maitoko, T., and Mizuguchi, K.

Kanzaki Paper Manufacturing Company, Limited, Hyogo, Japan,
and Niigat-Zimpro Limited, Tokyo, Japan. (assignees)

United States Patent 3,901,804. Issued August 26, 1975. Official Gazette of the United States Patent Office, Vol. 937, No. 4, p 1423, August, 1975. 1 fig.

One method treating of waste water involves adding a coagulant which is essentially a water-soluble aluminum compound. Sludge resulting from this treatment is then separated and subjected to wet air oxidation. An improvement of this method has been patented. The pH of the sludge is adjusted prior to wet air oxidation so that the sludge has a pH value of less than 1.5. This causes the formation of water-soluble aluminum compounds in the oxidized sludge. The water-soluble aluminum compounds can then be separated from the sludge. Another improvement of the same process has also been patented. The pH of the sludge is adjusted prior to wet air oxidation to be greater than 10.5. This also causes the formation of water-soluble aluminum compounds in the sludge, which can subsequently be separated from the sludge.

*Patents, *Waste water treatment, *Coagulation, Separation techniques, Hydrogen ion concentration, Sludge treatment

Wet air oxidation

C214
A ROTARY APPARATUS FOR PURIFYING THE WATER BY ALTERNATELY CONTACTING THE SURFACE OF THE APPARATUS WITH AIR AND WATER,

Ahlgren, N. H.

Australian Patent 463,591. Issued July 31, 1975. Official Journal of Patents, Trade Marks, and Designs, Vol. 45, No. 27, p 3046, July, 1975.

Rotary water treatment equipment has been patented. The system is closed except for entrance and exit openings, and includes means for causing the apparatus to rotate. Contact surfaces for air and water are provided within the body of the apparatus, and are arranged so that water is advanced through the body and is purified. The rotary body has a buoyancy of its own and will rotate, supported by the water, and automatically adjust itself to the water level.

*Water purification, *Water treatment, *Patents, *Equipment, Aeration

Rotary systems

C215
WASTE CONVERTER,

Green, H. W., and Cook, O. F.

The Standard Products Company,
Cleveland, Ohio. (assignee)

United States Patent 3,906,873. Issued September 23, 1975. Official Gazette of the United States Patent Office, Vol. 938, No. 4, p 1575, September, 1975. 1 fig.

A method of sewage disposal has been patented. Equipment consists of a vaporizing chamber and means for discharging wastes downward into the chamber. Flaming combustion products are introduced into the chamber at a rate sufficient to maintain a flame-filled condition within the chamber. A high proportion of the sewage products are thereby vaporized and consumed. Exhaust means are connected to the upper portion of the chamber, and separation equipment is located in the exhaust means to remove solids from the exhaust.

*Patents, *Waste disposal, *Incineration, *Sewage disposal, Equipment

C216
METHOD OF WASTEWATER TREATMENT,

Torpey, W. N.

Autotrol Corporation,
Milwaukee, Wisconsin. (assignee)

United States Patent 3,905,899. Issued September 16, 1975. Official Gazette of the United States Patent Office, Vol. 938, No. 3, p 1233, September, 1975. 1 fig.

A method has been patented for the continuous treatment of waste water. A treatment tank is described, having a biological treatment zone in its upper part and a settling zone in its lower part. The settling zone is subadjacent to the biological treatment zone, and is actually an extension of that zone. Waste water is introduced into the biological treatment zone, while a predetermined depth of waste water is maintained in the treatment tank. A flow of waste water is created through this first zone and another flow of waste water in the opposite direction is created in the settling zone. Within the biological treatment zone there are several rotatably mounted parallel shafts, across the tank, transverse to the direction of waste water flow as well as several disc members mounted on each of the shafts which extend into the waste water. The disc members are thus rotated at a peripheral velocity, which is adequate to allow aerobic biological slimes to grow on the disc surfaces.

*Patents, *Biological treatment, *Waste water treatment, *Treatment facilities, Tanks, Flow, Slime

Rotating biological discs

C217
SEWAGE TREATMENT SYSTEM INCLUDING EFFLUENT EVAPORATOR,

Yost, K. J.

Coate Burial Vault, Incorporated,
West Milton, Ohio. (assignee)

United States Patent 3,907,679. Issued September 23, 1975. Official Gazette of the United States Patent Office, Vol. 938, No. 4, p 1837, September, 1975. 1 fig.

A patented sewage treatment system is described which includes a tank buried within the ground. This tank has an inlet to receive sewage water and an outlet to discharge a clear water effluent. An evaporation device is provided to evaporate the effluent into the atmosphere. The evaporation equipment consists of an elongated flexible tubular conduit system of plastic material, which is arranged to form a substantially flat horizontal coil buried within the ground. This conduit system has an inlet end portion connected to the outlet of the tank which receives the effluent, an outlet end portion, and means to vent the outlet end portion to the atmosphere above the ground. This is accomplished by means of an air supply tube connected to the conduit system along several longitudinally spaced intervals of the conduit system. Thus, several air streams are produced into the conduit system, producing a longitudinal flow of air in a common direction within the upper portion of the conduit system for discharge as vapor to the atmosphere through the conduit system outlet.

*Patents, *Sewage treatment, *Waste water treatment, *Tanks, Equipment, Conduits

C218
FILTER-PRESS FOR DRYING WASTE AND SEWAGE SLUDGES,

French Patent FR 2242-133. Issued May 2, 1975. Derwent French Patents Abstracts, Vol. W, No. 23, p D3, July, 1975.

A patent was issued for a filter press which dewaters waste water and sewage sludges. The press consists of two endless filtering bands which are guided around a roller assembly to follow concentric trajectories, one on the inside and the other around a common arc. The sludge to be treated is pumped into a mixer where it is flocculated; the mixture then passes through a reaction chamber which is provided with a wide overflow. Sludge is pressed between the two bands by the pressure of adjustable rollers. The water is squeezed out and this is collected by metallic plates. The system is very compact, and the sludge is treated in successive stages for an increased drying effect.

*Filters, *Dewatering, *Waste water treatment, *Patents, *Sewage treatment, Equipment, Sludge treatment

*Filter presses

C219
AERATING PROPELLOR FOR BIOLOGICAL PURIFICATION OF WASTE WATER,

Netherlands Patent NL 7416-582. Issued July 25, 1975. Derwent Netherlands Patents Abstracts, Vol. W, No. 32, p D1, September, 1975.

A patented aerating propellor for the biological treatment of waste water is described. This power driven, high speed rotary propellor is mounted on the end of a hollow shaft. An air inlet above the surface of the liquid in which the propellor is immersed induces vigorous aeration of the liquid via an air outlet at the end of the shaft. The propellor has at least one helical blade extending around at least two-thirds of the circumference of the shaft. Polluted liquid is vigorously aerated to improve biological purification by increasing the bacterial action to oxidize dissolved organic matter. A compact and powerful jet is directed axially from the propellor and will disperse dead pockets, prevent sedimentation, and avoid stagnation. Because the aerating efficiency is higher than with conventional agitators, reduced power requirements and low blade stresses are found.

*Patents, *Aeration, *Biological treatment, *Waste water treatment, Liquid wastes, Organic matter

*Aerators, Propellors

C220
PRESSURE SEWER SYSTEM,

Farrell, R. P., Jr., Grace, R. C., and Doyle, W. J.

Equipment/One Corporation,
Schenectady, New York. (assignee)

United States Patent 3,904,131. Issued September 9, 1975. Official Gazette of the United States Patent Office, Vol. 938, No. 2, p 643, September, 1975. 1 fig.

A patent has been issued for a pressure sewer system. This sewage transport system includes a combination of several sewage generating sites, each of which includes at least one collection tank. A grinder is arranged so that the liquid sewage is suctioned from the tank and ground liquid slurry sewage is discharged from its outlet. A pump has its inlet connected to the outlet of the grinder and provides a significant discharge flow of ground liquid slurry sewage under pressure from its outlet. Outlet check valves within the discharge passage permit liquid sewage to flow only to the direction from the outlet of the pump to a receiving point and prevent backflow of pressurized liquid sewage.

*Patents, *Sewers, *Sewerage, *Waste water treatment, *Sewage treatment, Liquid wastes, Pumps

*Pressure sewers

C221
BIOLOGICAL PURIFICATION OF WASTE WATER AND SEWAGE,

French Patent FR 2238-675. Issued March 28, 1975. Derwent French Patents Abstracts, Vol. W, No. 19, p D3, June, 1975.

A system of biological purification of waste water and sewage has been patented which involves algal and bacterial symbiosis. The conventional activated sludge process reduces the BOD but only has a slight effect on nitrogen and phosphorus levels. This new process results in a more rapid reduction of the BOD and COD; it also reduces nitrogen, phosphorus, and pathogenic germs. Water is fed into a tank and is illuminated by appropriately placed lamps. Automatic stirring takes place. Unicellular algae and bacteria, naturally present in the water to be treated, grow considerably in the illuminated medium. Bacteria, using the oxygen supplied by the algae, degrade the organic matter and liberate carbon dioxide. Mineral matter is assimilated by the algae. Water is pumped to a pressurized enclosure equipped with candle filters and the filtered water is collected. Secondary or tertiary treatment may also be effected in the same tank and the algal material can be collected and reused.

*Patents, *Biological treatment, *Bacteria, *Algae, Nitrogen, Phosphorus, Nutrient removal, Biochemical oxygen demand, Chemical oxygen demand, Waste water treatment, Equipment

Symbiosis

C222
ACTIVATED SLUDGE TREATMENT TANK WITH CENTRAL AERATOR,

German Patent DS 2324-678. Issued July 31, 1975. Derwent German Patent Abstracts, Vol. W, No. 32, p D1, September, 1975.

A patent has been granted for an activated sludge treatment tank with a central aerator. One or several pipe lines are provided in addition to pipe lines connected to a standpipe. These are adjustable in height and end in the region of the water surface of the after clarification chamber (ACC). The additional pipe lines terminate in a shaft arranged outside of a circular basin. The shaft is constructed to allow the waste water flowing through enough time to separate out the floating sludge on the water surface and to prevent a short circuiting of the flow between the two pipe lines. The shaft is equipped with an overflow weir adjustable in height, located before the mouth of the pipe line ending in the region of the water surface of the ACC. A regular withdrawal of excess floating sludge from the ACC is possible, maintaining good control over this removal process.

*Patents, *Activated sludge, *Aeration, *Clarification, Biological treatment, Waste water treatment, Separation techniques, Equipment

Aerators, After clarification chamber (ACC)

C223
THICKENING ACTIVATED SLUDGE FROM EFFLUENT TREATMENT PLANTS,

Netherlands Patent NL 7316-640. Issued June 9, 1975. Derwent Netherlands Patents Abstracts, Vol. W, No. 25, p D1, July, 1975.

A method for thickening activated sludge from biological treatment plants has been patented. The concentration of sludge discharged from an effluent purification plant may be increased by allowing the flocs of sludge to settle in a reservoir in the presence of heavy particles introduced into the liquid. The settled material is supplied to at least one hydro-cyclone in which the sludge flocs are separated from the heavy particles which are recycled to the reservoir. Sludges which settle only with difficulty and/or very slowly may be thickened with this system and will achieve concentrations suitable for centrifugation. These heavy particles have a high specific gravity relative to the sludge flocs and a particle size of 10 to 100 microns. They may consist of magnetite, ferrosilicon, or suitable types of sand or loess. The concentration of heavy particles used to entrain the sludge should be less than 25 g/liter.

*Patents, *Dewatering, *Waste water treatment, *Sludge treatment, Activated sludge, Biological treatment, Recycling, Treatment facilities

*Sludge thickening

C224
METHOD AND APPARATUS FOR THE PURIFICATION OF AQUEOUS EFFLUENT,

Kaelin, J. R.

United States Patent 3,910,838. Issued October 7, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 1, p 340, October, 1975. 1 fig.

A patented method for treating liquid wastes has been described. Effluents are conducted directly into one end of a closed mixing tank. This tank is located within a residence tank of larger capacity. Oxygen or an oxygen mixture is supplied to the effluent as it is conducted into the mixing tank. This oxygenated liquid is then passed through an extended flow path within the mixing tank, increasing the reaction between the oxygen and the effluent. The oxygenated waste is then discharged from the other end of the mixing tank into the residence tank through several conduits. These conduits are arranged near the floor of the residence tank and oriented so that a strong rotary flow is produced in this region, avoiding the formation of sludge deposits. Part of the oxygenated effluent is recycled back into the mixing tank, and excess oxygenated effluent is removed from the residence tank.

*Patents, *Aeration, *Oxygen, *Waste water treatment, *Liquid wastes, Equipment, Effluents, Tanks, Mixing, Tanks

C225
PROCESS FOR TREATING SEWAGE SLUDGE,

Neukamm, H. H., Young, H. J., Young, T. L., and Tanner, M. J.

United States Patent 3,909,410. Issued September 30, 1975. Official Gazette of the United States Patent Office, Vol. 938, No. 5, p 2396, September, 1975. 1 fig.

A process for treating sewage sludge was patented. It comprises a rotating contactor drum into which aggregate pieces preheated to 212-325 F are continuously introduced. These aggregate pieces are coated with a slurry of sewage sludge and then carried upwards by a series of longitudinal baffles which extend the length of the contactor drum's cylindrical wall. Any slurry not adhering to the aggregate pieces is recycled into the drum's lower region. The coated aggregate pieces are dumped into a downwardly inclined collector trough in the upper region of the drum, where they are subjected to external drying heat. Then tumbling in an inclined tumbler drum separates the dried slurry encrustations from the aggregate pieces. The pulverized encrustations are collected by air currents and the decoated aggregate pieces are recycled through the system. Sufficient numbers of fresh aggregate pieces are added to maintain a constant flow into the contactor drum.

*Sewage treatment, *Sludge treatment, *Patents, Waste water treatment, Slurries, Aggregates, Recycling

Contactor drum, Tumbler drum

C226
SEPTIC TANK TEE,

Maroschak, E. J.

United States Patent 3,904,228. Issued September 9, 1975. Official Gazette of the United States Patent Office, Vol. 938, No. 2, p 676, September, 1975. 1 fig.

A septic tank tee adapted for use with a septic tank was patented. It is formed of plastic, and has an elongate tubular body with open opposite ends and a relatively short tubular branch member, also with open opposite ends. One end of the branch member is secured to the body member between its ends and perpendicular to it. The branch member carries a split collar to aid in anchoring the tee in operative position to the septic tank. In operative position the tee's body member will be upright within the tank and its branch member will extend through an opening in the tank's side wall. The end of the split collar closest to the body member will extend out from the branch member and will engage the septic tank's outer wall. The split collar has an outer circumferential extent corresponding to the outer circumference of the branch member which carries it, and it is secured to the branch member.

*Septic tanks, *Patents, *Sewage disposal, *Waste disposal, Equipment

*Septic tank tee

C227
METHOD AND APPARATUS FOR PURIFICATION,

Stopka, K.

United States Patent 3,904,521. Issued September 9, 1975. Official Gazette of the United States Patent Office, Vol. 938, No. 2, p 766-767, September, 1975. 1 fig.

A method has been patented for purifying flowing water containing wastes. The waste water is passed through a chamber; an ozone-containing atmosphere is provided above the water. The water is then agitated as it flows through the chamber and is propelled upward into the ozone atmosphere, and against the chamber walls. A film of waste is produced on these walls, preventing the formation of a humid atmosphere of suspended droplets. The film of waste is contacted with the ozone atmosphere and the wastes are oxidized. Purified water may then be recovered.

*Patents, *Water purification, *Waste water treatment, *Equipment, *Ozone, Oxidation, Water treatment, Recycling

C228
SURFACE VENTILATION ROTOR,

Kaelin, J. R.

Canadian Patent 972,485. Issued August 5, 1975. Patent Office Record, Vol. 103, No. 31, p 85-86, August, 1975.

A surface aeration rotor has been patented for adding oxygen or an oxygen mixture into waste water to be clarified. Equipment includes at least two annular blade sets, an inner blade set and an outer blade set, each including several blades. These define the outer and inner fluid channels. The sets are concentric and a dividing wall is located between the blade sets. The innermost channels are curved within vertical planes so that the waste water entering the inner channels from below is deflected within these channels though an angular displacement of about 90 degrees. Waste water than emerges from the periphery of the rotor in an almost horizontal direction. The outer channels are inclined vertically upward and radially outward; waste water entering these outer channels from below is conducted so that it emerges from the periphery of the rotor in paths which intersect the horizontal exit paths of the inner channels. Thus, intensive mixing of the waste water exiting from the fluid channels takes place.

*Patents, *Aeration, *Oxygen, *Waste water treatment, Equipment, Mixing

Surface aeration rotor

C229
SLUDGE DEWATERING PROCESS AND APPARATUS,

Degremont, S. A.

Australian Patent 463,062. Issued July 17, 1975. Official Journal of Patents, Trade Marks and Designs, Vol. 45, No. 25, p 2805, July, 1975.

A patent has been issued for a process to dewater flowing liquids which contain suspended solids and water. The effluent is passed onto the top surface of an endless screen belt which has openings sized to retain the suspended solids. Free water drains through the belt, and conveys the partially dewatered material. The top of the screen belt is close to a moving capillary belt with pores sized so as to develop a capillary force with respect to the remaining water in the liquid. This liquid material is further dewatered; the capillary belt is repeatedly diverted away from the moving screen belt and the absorbed water is squeezed out of the capillary belt each time. The dewatered material is transferred from the screen belt to a roller for subsequent discharge into a container.

*Patents, *Dewatering, *Waste water treatment, *Liquid wastes, Suspended solids, Screens, Waste disposal, Equipment

Endless screen belts

C230
INSTALLATION FOR SEWAGE TREATMENT,

Cherne, L. G., Grounds, H. C., and Halvorson, H. O.

Cherne Industrial, Incorporated,
Edina, Minnesota.

United States Patent 3,905,904. Issued September 16, 1975. Official Gazette of the United States Patent Office, Vol. 938, No. 3, p 1235, September, 1975. 1 fig.

A patent has been issued for a sewage treatment facility. The installation is an open topped activated sludge sewage aeration treatment channel with a bottom and sides which form an endless closed loop path. This path provides a variable volume activated sludge treatment reservoir for containing and treating a biological mixed liquor. There is a device for delivering partially treated sewage into the activated sludge treatment chamber at one location along the path at variable volume rates. The delivery rates usually correspond to the normal variations in volume rates at which the raw sewage is received. The sewage is continuously circulated with activated sludge as mixed liquor in one direction around the closed loop path in the channel at a linear rate of flow which will prevent settling out of suspended solids in the channel. The mixed liquor is passed to a sludge settling tank at a relatively constant rate by a feeding device. The volume rate will be at least equal to the average of the variable volume rates at which the sewage is delivered to the activated sludge treatment reservoir. The mixed liquor is separated into sludge and remaining clear liquid effluent in the sludge settling tank. Overflow means are provided for feeding the mixed liquor from the treatment channel to the sludge settling tank at a higher rate than normal whenever the depth of the liquor in the channel exceeds a given maximum level.

*Sewage treatment, *Waste water treatment, Treatment facilities, Activated sludge, Patents, Equipment, Sludge, Settling basins

C231
SEWER AUGERING MACHINE,

Silverman, L. H., Silverman, A. A., and Gworski, E. T.

Canadian Patent 974,010. Issued September 9, 1975. Patent Office Record, Vol. 103, No. 36, p 3, September, 1975.

A patent has been issued for a plumber snake apparatus that consists of a snake coiled inside of a changeable snake cartridge housed in a cartridge housing. A handgrip at the forward end of the housing is provided for gripping the tool as the snake within the pipe being cleaned is rotated with the housing. When the handgrip is axially displaced rearward, a chuck is automatically actuated to grip the snake and prevent further axial feed.

*Sewers, *Pipes, *Cleaning, *Patents, Equipment, Plumbing

Plumbing snakes

C232
METHOD AND APPARATUS FOR CONTINUOUS MONITORING OF DISSOLVED ORGANICS,

Claus, G.

Canadian Patent 974,082. Issued September 9, 1975. Patent Office Record, Vol. 103, No. 36, p 18, September, 1975.

A method and equipment that can be used to measure and continuously monitor the amount of dissolved organics has been patented. The quantity of dissolved organic material in a solvent medium is measured by passing 280 millimicron light through the medium. The amino acid tyrosine in the medium will absorb radiation of this wavelength. The concentration of tyrosine can be determined by measuring the adsorbance of the radiation. The amount of organic material is then calculated by using the known proportional relationship of tyrosine to the total organic matter.

*Monitoring, *Measurement, *Dissolved solids, *Organic compounds, *Patents, Radiation, Wavelengths, Equipment

Tyrosine

C233
METHOD AND APPARATUS FOR PROCESSING REFUSE, SEWAGE AND/OR WASTE MATERIAL INTO A SOURCE OF ENERGY,

Jackman, V., McKeever, J. V., Ferguson, H. F., and Sotak, J. B.

United States Patent 3,910,775. Issued October 7, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 1, p 323, October, 1975. 1 fig.

A system has been patented for the processing of refuse and sewage into a stable fuel material. Collected heterogeneous refuse is collected, and ferro-magnetic objects are separated out. The collected refuse is then shredded; waste is added; and the mixture is compressed, dewatered, and fed to a filtration system. Raw sewage is passed through the filter bed where solids, matter in suspension, and precipitates are filtered from the raw sewage by filter briquettes. Expended filter briquettes are removed from the filter bed, and these are dewatered and made into pellets. Waste is then mixed with the pellets, and the entire mixture is again compressed, dewatered and briquetted into a form of fuel.

*Patents, *Dewatering, *Waste disposal, Recycling, Fuels, Sewage, Waste water treatment, Filtration, Equipment, Suspended solids

*Refuse

C234
PLANT FOR WASTE WATER TREATMENT,

Hampton, Q. L., and Matras, E. J.

Canadian Patent 974,336. Issued September 9, 1975. Patent Office Record, Vol. 103, No. 36, p 74, September, 1975.

A patent has been issued for a waste water treatment facility. Equipment is provided for converting a basic unitary tank structure into a series of communication treatment zones. This is achieved by introducing a self-supporting modular settling tank with liquid fillable fillets as part of the structure. Thus the member may be anchored in position, providing watertight tank member segments which operate as cooperative treatment zones. The modular tank member provides the basic support structure for the aeration system required to convert an adjacent tank segment into an aeration zone. It also effects the removal of sludge separated in the modular tank member from mixed liquor received from the aeration zone. Therefore, part of the sludge can be returned to the aeration tank and the remainder discharged to any additional treatment zones.

*Patents, *Waste water treatment, *Tanks, *Aeration, Sludge treatment, Separation techniques, Treatment facilities, Biological treatment, Equipment

Modular settling tanks

C235
MINI SEWAGE TREATMENT SYSTEM,

Call, D. H., Atwood, E. L., Cary, J. A., and Surette, J. D.

United States Patent 3,914,173. Issued October 21, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 3, p 1461, October, 1975. 1 fig.

A treatment method for raw sewage has been patented. The sewage is passed to a primary digestion tank where it is digested by bacterial action. From the primary digestion tank, the sewage is conducted to a second stage digestion tank to obtain more complete bacterial action and further digestion. The digested product is selectively passed from the second tank alternately through one of two strainers composed of plastic screening material with approximately a one fourth inch mesh. The product from the strainers is then passed to each of three settling tanks for a predetermined amount of time, permitting any remaining sediment to settle to the bottom of the tank. A portion of the product from the settling tanks is returned to the primary digestion tank for recirculation at predetermined intervals. The settling tanks product is selectively passed to one of two filtering and odor neutralizing cells in an alternate sequence, which is controlled according to the fluid conducting conditions of the cells. From the filtering and odor removal cell, the product then passes to an aeration-radiation unit, where it is broken up into minute particles and treated with sterilizing ultra-violet radiation. The resultant product is a reusable odorless liquid.

*Patents, *Waste water treatment, *Irradiation, *Biological treatment, *Sewage treatment, Sedimentation, Odor, Aeration, Ultraviolet radiation, Filtration, Water reuse

C236
APPARATUS FOR THE SEPARATION OF DIFFICULTY MISCIBLE OR NON-MISCIBLE LIQUIDS,

Kunz, O., Hartmann, R., and Sinnersdorf, N.

United States Patent 3,914,175. Issued October 21, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 3, p 1461-1462, October, 1975. 1 fig.

A patent has been issued for a separation device for liquid dispersions of two or more mutually insoluble or partially soluble liquids. These are separated into individual liquid phases in a separating tank which has side walls and an inlet for the liquid mixture, and zig-zag shaped plate-like fittings arranged in layers one over the other in the tank. These fittings extend across the tank from side wall to side wall, horizontally in the direction of the liquid throughput. Outlets are located in the peaks and valleys of the overlapping fittings for separating the phases. A diffusion device operates in the form of a fiber or ribbon adjacent to the inlet for the uniform distribution of the liquids as they are separated. A perforated plate extends across a cross-section of the tank, following the diffusing means and immediately preceding the plate-like fittings.

*Patents, *Separation techniques, *Liquids, Equipment, Tanks

C237
FLUIDIZED BED FURNACE HAVING COARSE PARTICLE DISCHARGING DEVICE,

Albrecht, E., Oepke, W., and Wulfmeier, H.

Rheinstahl AG,
Germany. (assignee)

United States Patent 3,910,208. Issued October 7, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 1, p 133-134, October, 1975. 1 fig.

A patent was granted for a fluidized bed furance for dehydrated sludge. The equipment consists of a furnace housing on which the bed is supported. Combustion air is directed upward through the bottom of this housing to reduce the sludge to fine ash. The ash passes out of the furnace with part of the combustion air. Coarse particles are also generated. The equipment is detailed for admitting the sludge material to the combustion chamber. Connected to the fluidized bed furnace is a discharge passage. This passage has a rotatable drum portion with an interior wall; a screw thread extends at the proper angle so that the spacing between successive thread windings is large enough for the largest size particles expected to be formed in the fluidized bed to pass through. A central passage is also located between the threads to permit the passing of smaller sized particles.

*Patents, *Incineration, *Sludge treatment, *Sludge disposal, Waste water treatment, Equipment

*Fluidized bed furnace

C238
SYSTEM AND PROCESS FOR BACTERIAL REDUCTION OF WASTES,

Clark, J. W.

United States Patent 3,914,164. Issued October 21, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 3, p 1458-1459, October, 1975. 1 fig.

A method for treating waste water containing biodegradable organic matter has been issued a patent. The waste water effluent is introduced into the treatment tank. Gas bubbles are electrolytically generated beneath the surface of the effluent in the lower reaches of the tank. This reduces the detrimental effects of flotation, prevents turbulent mixing caused by the rapid vertical rise of bubbles, maximizes the utilization of oxygen for bacteria and other high life forms, and gently mixes the waste water. A completely mixed environment is formed which contains sufficient dissolved oxygen for bacterial action while preventing the dispersion and break up of the floc. The floc is maintained within the range from 100 to 200 microns and contains bacteria and substrate upon which protozoa and other higher life forms feed. The effluent from the tank is low in biochemical oxygen demand, suspended solids, and fecal coliforms.

*Waste water treatment, *Patents, Biodegradation, Flocculation, Bubbles, Aeration, Mixing, Biochemical oxygen demand, Suspended solids, Coliforms, Bacteria

C239
HEAT TREATMENT OF WASTE SLUDGES,

Paccione, J. D., Ellyn, G., and O'Meara, D. M.

Chicago Bridge and Iron Company,
Oak Brook, Illinois. (assignee)

United States Patent 3,913,500. Issued October 21, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 3, p 1237, October, 1975. 1 fig.

A method for the incineration of high moisture sewage sludge has been patented. A combustion chamber is provided which contains hot inert granular material which has heat-storing and heat radiating capabilities. An oxygen containing fluidizing gas is supplied to the granular matter to form a fluidized bed. The sewage sludge is fed continuously through a heat exchange means located in heat exchange relationship with the fluidized bed. The sludge is heated to an elevated temperature and held at an elevated temperature and pressure for a duration sufficient to allow effective conditioning. The conditioned sludge is dewatered, raising the solids level to a minimum of 10% by weight. The dewatered sludge is fed into the fluidized bed where it is incinerated.

*Waste water treatment, *Waste water disposal, *Sludge treatment, *Incineration, Sludge disposal, Dewatering, Heat treatment, Patents, Equipment

Conditioning, Fluidized bed incinerators

C240
METHOD AND APPARATUS FOR THE DISINFECTION OF LIQUIDS BY ANODIC OXIDATION AND PRECEDING REDUCTION,

Eibl, V., and Reis, A.

Sachs-Systemtechnik GmbH,
Schweinfurt, Germany. (assignee)

United States Patent 3,910,829. Issued October 7, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 1, p 337, October, 1975. 1 fig.

A method for the disinfection of an aqueous liquid contaminated with microorganisms has been patented. The liquid is passed sequentially through the first compartments of two electrolytic cells. Each cell comprises two compartments separated from each other by a permeable diaphragm, and each contains an electrode. Direct electric current is passed through the liquid in the first cell utilizing the electrode in the first compartment as the cathode and the electrode in the second compartment as the anode. Direct electric current is passed through the liquid in the second cell utilizing the electrode in first compartment as the anode and the electrode in the second compartment as the cathode. The liquid is thereby purified and then withdrawn from the first compartment of the second cell.

*Waste water treatment, *Liquid wastes, *Disinfection, *Electrolysis, Electrodes, Cathodes, Anodes, Patents, Equipment, Microorganisms

C241
AEROBIC SEWAGE DIGESTION SYSTEM,

Milne, G. A.

United States Patent 3,907,672. Issued September 23, 1975. Official Gazette of the United States Patent Office, Vol. 938, No. 4, p 1835, September, 1975. 1 fig.

An aerobic sewage digestion system has been patented. The apparatus comprises a closed tank with a cylindrical wall oriented around a generally horizontal axis. A sewage inflow opening is located in one end wall, and an effluent outflow opening is located in the other end wall. The tank is divided into three chambers. The first chamber acts as the pre-treatment compartment. Aeration means extend downwards and along the bottom of the central chamber for releasing oxygen bearing material into the sewage and promoting upward circulation. The sewage flows from the central chamber into the third chamber while solid materials from the third chamber are returned to the central chamber. Modified "T"s direct the flow of sewage downward in the first chamber, and upward into the central chamber. Manways are constructed around the three chambers which allow access to the chambers.

*Waste water treatment, *Sewage treatment, *Aerobic conditions, Digestion, Patents, Digestion tanks, Equipment, Treatment facilities

Aerobic digestion

C242
FINE SIEVING DRUM FOR SOLID MATTER SUSPENDED IN WATER,

French Patent FR 2255-936. Issued August 29, 1975. Derwent French Patents Abstracts, Vol. W, No. 42, p D2, November, 1975.

A patent has been issued for a fine sieving drum to treat solids suspended in water from sewage digestion tanks. The suspension is fed into the drum which has sealed end faces, rotating within an enclosed vessel. Clarified water is passed through woven wire mesh covering the drum; the solid matter is carried to a zone vertically above the axis of the drum. A higher pressure exists within the drum to prevent the solid matter from falling back into the sieve pool. This pressure, which holds the solids on the sieve without destroying the film of water across the holes, varies from 2.5 mm and 150 mm water column. The process is capable of achieving an effluent with 10 ppm of suspended solids.

*Patents, *Suspended solids, *Sewage treatment, *Separation techniques, Waste water treatment, Equipment

Sieving drums

C243
SETTLING TANKS,

South African Patent ZA 7303-195. Issued July 31, 1975. Derwent French Patents Abstracts, Vol. W, No. 42, p D1, November, 1975.

The design of a settling tank has been patented. The tank has a flat base and a wall surrounding the base. Liquid to be treated is fed to a lower portion of the tank where a sludge blanket is maintained. A sludge concentrating receptacle is also located within the lower portion of the tank and defines a quiescent zone. The receptacle has an inlet above the base of the tank where sludge particles are received from the surface of the sludge blanket. An outlet discharges concentrated sludge from the receptable.

*Patents, *Sludge treatment, *Sludge disposal, Tanks, Equipment

Sludge concentration

C244
INCINERATOR AND SYSTEM FOR CLEANING PRODUCTS OF COMBUSTION,

Brown, K. D.

United States Patent 3,911,836. Issued October 14, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 2, p 677, October, 1975.

An incinerator and combustion product cleaning system for burning sewage has been patented. A preheating chamber heats and partially dries the moist waste to be burned. Waste is supplied to the preheating chamber and passes by a conveyor to a combustion chamber. Blowers supply air to the combustion chamber. A liquid vortex type vacuum pump is used to withdraw gaseous matter from both chambers and to clean the withdrawn gas.

*Incineration, *Waste disposal, *Sewage treatment, *Cleaning, *Patents, Equipment, Pumps, Burning

C245
IMPROVING QUALITY OF LEACHATE FROM SANITARY LANDFILLS,

French Patent FR 2256-114. Issued August 29, 1975. Derwent French Patents Abstracts, Vol. W, No. 42, p D3, November, 1975.

A patent has been issued for a process for improving quality of leachates from sanitary landfills. Waste material is treated by mixing it with an aqueous solution of an alkali metal silicate and a silicate settling agent containing polyvalent metal ions. This converts the mixture into a consolidated chemically and physically stable earth-like material, substantially insoluble in water. Its pollutants are entrapped in the solidified silicate. The landfill material and treated waste material are disposed of in contact with each other so that the leachate will trickle down through the treated waste material. A frequently used setting agent is Portland cement.

*Patents, *Water quality control, *Leachate, Landfills, Waste disposal, Cement, Metals

*Sanitary landfills

C246
CORRUGATED DRAIN PIPE,

Soviet Patent SU 393400. Issued April 18, 1975. Soviet Inventions Illustrated, Vol. W, No. 42, p 1, November, 1975. 1 fig.

A patent has been granted for a corrugated drain pipe. The pipe has water openings at a vee-top and unequal chutes to increase strength and prevent blockage. Chutes are formed by the vee and space below the vee is filled with filtering material. One chute is provided for smaller effluent flows. Effluent is filtered through the filtering material; when flow increases so that the first chute becomes full, water overflows to the second chute. The corrugations outside the pipe increase its strength.

*Patents, *Drains, *Equipment, *Pipes, Flow rates, Construction materials, Filtration

Corrugated drain pipes

C247
CLARIFIER WITH FLOATING FILTERING MATERIAL,

French Patent FR 2255-935. Issued August 29, 1975. Derwent French Patents Abstracts, Vol. W, No. 42, p D2, November, 1975.

A clarifier has been patented for the rapid filtration of polluted liquids, including industrial effluents, waste water, and sewage. Low density filtering materials are arranged in a clarifying vessel and press against a retaining grid when the vessel is full. The grid can be made of a finely perforated metal sheet, wire gauze or a plastic material. Filtered liquid can be stored for use in counter current washing. When the filter is clogged, the vessel is partially emptied through a valve until the filtering material is de-compacted and the sludge eliminated. Liquid to be treated is filtered in an upward direction. Filtration may be combined with pre-settlement; heavy particles which would normally interfere with filtration are separated out in a simple step. Back-washing of the filter is rapid and requires only a small amount of water.

*Patents, *Filtration, *Waste water treatment, *Clarification, *Sewage treatment, *Filters, Sludge treatment, Separation techniques, Equipment

C248
SEPN OF WATER FROM AQUEOUS MIXTS,

Netherlands Patent NL 7503-699. Issued October 3, 1975. Derwent Netherlands Patents Abstracts, Vol. W, No. 42, p D3, November, 1975.

A process has been patented for the separation of water from aqueous mixtures by diffusion through membranes into liquids with temperature dependent miscibility. The mixture is brought into contact with one surface of an organic polymer membrane which is selectively permeable with respect to water. Part of the water will permeate into and through the membrane while the other surface of the membrane is contacted with a water-miscible "sweep-liquid" whose miscibility with water depends upon the temperature range of the membrane. The water-enriched miscible phase is removed from the second surface of the membrane and the temperature of the "sweep-liquid" is altered to a temperature outside the miscibility range. Thus, two liquid phases are formed which may be separated. The process has low energy requirements and low costs.

*Separation techniques, *Patents, *Liquid wastes, *Effluents, Membrane processes, Temperature, Waste water treatment, Polymers

C249
BIOLOGICAL AEROBIC PURIFICATION OF EFFLUENT,

South African Patent ZA 7405-313. Issued July 29, 1975. Derwent French Patents Abstracts, Vol. W, No. 42, p D2, November, 1975.

A method of activated sludge treatment has been patented which uses an interchangeable aerator and clarifier. In this process, two adjacent basins are used for effluent treatment. The wastes to be purified are supplied to one basin which acts as the activated sludge basin; oxygen or an oxygen mixture is supplied to this basin. After a predetermined residence time, the effluents are passed to the second basin which acts as the final purification basin. Purified water is removed from the second basin until the activated sludge concentration in the first basin drops below a given value. The direction of operation is then changed, so that the second basin functions as the activated sludge basin and the first basin as the final clarifier.

*Patents, *Biological treatment, *Activated sludge, *Aeration, Waste water treatment, Oxygen, Equipment, Effluents, Clarification

C250
WASTE MANAGEMENT SYSTEM,

Dirk, H. D.

United States Patent 3,912,598. Issued October 14, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 2, p 924, October, 1975.

A patent has been granted for a waste management system. Equipment consists of a waste holding tank, a container for pressurized fuel-gas, and means for pressurizing the holding tank. A conduit is located between the waste holding tank and the container. A reaction chamber includes an outer shell, the interior of which is divided into upper and lower chambers. Within the lower chamber is a burner unit; within the upper chamber is at least one waste discharge nozzle, which is connected to the waste holding tank and discharges into the reaction chamber. Immediately above the nozzle are catalytic purifying means which contain material to be contacted by the vapor products. The fuel gas is ignited at the burner unit. Vaporization products of the reaction are condensed into liquid water and further purified by filtration. Conduits then direct the vaporization products to a potable water tank.

*Waste treatment, *Waste disposal, *Patents, *Burning, *Filtration, Condensation, Potable water, Catalysts, Equipment

C251
CATALYZED PROCESS AND CATALYST RECOVERY,

Ely, R. B., Pogainis, E. M., and Hoffman, C. A.

Sterling Drug, Incorporated,
New York, New York. (assignee)

United States Patent 3,912,626. Issued October 14, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 2, p 931-932, October, 1975. 1 fig.

A patent has been issued for a method of waste water treatment by wet oxidation. The oxidation is performed at a temperature between 150 and 340 C and a pressure between 200 and 4000 psi in the presence of either cupric or silver ion in a concentration between 10 and 10,000 mg/liter. The resulting oxidized waste water is subjected to liquid-solid separation to remove non-catalytic suspended solids. The liquid phase is then treated with a source of sulfide ions which reacts with the cupric or silver ion, forming an insoluble precipitate containing cupric or silver sulfide. The precipitate is then separated from the liquid phase and reintroduced into the wet oxidation reactor. Thus, silver or cupric ions are regenerated for the catalysis of additional waste water.

*Patents, *Waste water treatment, *Oxidation, *Chemical precipitation, *Separation techniques, *Solids removal, Suspended solids, Catalysts

Cupric ion, Silver ion, Wet oxidation

C252
WATER CLARIFICATION SETTLER,

Soviet Patent SU 446472. Issued May 16, 1975. Soviet Inventions Illustrated, Vol. W, No. 43, p D5, December 2, 1975.

A patent has been granted for a water clarification settler. The clarifier is partitioned and has a multilayer charge in its upper section, while its lower section forms a sludge compression chamber. Clarification is accelerated with truncated conical baffles, located over the sludge compression chamber, on the center line of the unit. The baffles have their larger end up and are made with side ports. The lower section has clarified water inlets and a chamber filled with gravel to encourage agglomeration and to guide liquids to the multilayer charge area. Baffles with ports separate the clarification zones from the compression zones. Sludge is removed through channels and clarified water is removed through tubes.

*Patents, *Water treatment, *Sludge disposal, *Clarification, Sedimentation, Equipment, Treatment facilities

Sludge compression chamber, Clarification chamber

C253
WASTEWATER TREATMENT,

Torpey, W. N.

Autotrol Corporation,
Milwaukee, Wisconsin.

United States Patent 3,915,854. Issued October 28, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 4, p 2090, October, 1975. 1 fig.

A patented method for treating waste water containing carbonaceous pollutants, expressed in terms of BOD and ammonia nitrogen in a weight ratio of at least 3.6:1 is described. Steps include removing settleable and flotable solids from the waste water; supplying the waste water to a holding tank and storing it there; passing the waste water at a predetermined rate from the holding tank to a biological treatment unit; and directing the biologically treated waste water to a final clarifier. In the clarifier, where suspended solids are removed, biological treatment includes not more than a single rotatable shaft supporting several partially submerged biological contactors. These have a surface area for the growth and maintenance of organisms, and create a flow of waste water through the biological treatment unit in a direction generally perpendicular to the rotatable shaft. The shaft is rotated to impart a predetermined peripheral velocity to the biological contactors, alternately exposing the surface area to waste water and an oxygen-containing atmosphere. The rate and peripheral velocity are chosen to simultaneously oxidize at least 83 weight percent of the BOD and at least 46 weight percent of the ammonia nitrogen.

*Waste water treatment, *Patents, *Biological treatment, *Oxidation, Equipment, Suspended solids, Ammonia, Nitrogen, Biochemical oxygen demand

C254
WASTE WATER AND SEWAGE TREATMENT,

French Patent FR 2256-902. Issued September 1, 1975. Derwent French Patents Abstracts, Vol. W, No. 43, p D3, December 2, 1975.

A method of waste water and sewage treatment using dissolved oxygen and activated sludge has been patented. Wastes containing biodegradable impurities are treated in one or more enclosures. The contacts between the waste water, the activated sludge, and the dissolved oxygen are intensified by increasing the number of interfaces and by shortening the diffusion paths in the sludge floccules. This is accomplished by injectors, used with a liquid nozzle, an annular, concentric nozzle for the gas, and an impulse exchange tube. A liquid jet leaves the nozzle at a speed of 29 m/sec and sets up a shear gradient in the activated sludge. The air bubbles are finely divided and the sludge is simultaneously sucked into the zone of the jet and intensely mixed in the tube. Sludge leaving the tube is saturated with oxygen; gases within the sludge cause it to rise in the form of a bubbling column to the surface of the activated sludge. The quantity of sludge which can be treated per unit of volume per day is twice that of a conventional biological treatment facility.

*Waste water treatment, *Sewage treatment, *Biological treatment, *Activated sludge, *Dissolved oxygen, *Patents, Aeration, Sludge treatment, Oxygen, Biodegradation

C255
SUBMERGED AIR RELEASE DEVICE PARTICULARLY FOR SEWAGE TREATMENT,

Moloney, J. I.

Envirex, Incorporated,
Waukesha, Wisconsin. (assignee)

United States Patent 3,915,862. Issued October 28, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 4, p 2093, October, 1975. 1 fig.

A patent has been issued for a submerged horizontal air supply header which operates in combination with a sewage aeration tank. This release device discharges air from spaced orifices arranged within the tank in a line such that rising air bubbles induce a general rolling motion of the sewage. The sewage liquid is swept across the floor of the tank toward the header, where several air diffuser devices are attached. Each diffuser comprises a box-like structure including a top, side, and end walls forming a chamber which opens downwardly and has a number of orifices near its top. In normal operation, the lower part of the chamber is partially filled with sewage up to the hydrostatic pressure level of the air supply but below the orifices. The entire lower end of the diffuser is open and of substantial horizontal length. The sweep of the sewage toward the header, therefore, extends to the air-sewage interface in the diffuser chamber and prevents the accumulation of biological slime.

*Waste water treatment, *Sewage treatment, *Aeration, *Patents, Equipment, Biological treatment, Slime

Air diffusers, Air release device

C256
SEWAGE TREATMENT,

Luck, E.

United States Patent 3,915,853. Issued October 28, 1975. Official Gazette of the United States Patent Office, Vol. 939, No. 4, p 2090, October, 1975.

A method has been patented for the treatment of liquid sewage containing both organic and inorganic compounds. These may include: a precipitable metal or metals; a compound containing any combination of starches, proteins, glycerides, and sugars; and pathogenic or other bacteria. The process involves adding to the sewage one or more alkaline compounds selected from the group of alkali metal carbonates, alkali metal bicarbonates, and alkali metal hydroxides to precipitate out the metals as insoluble carbonates, bicarbonates, hydroxides, or oxides. These precipitated materials are removed from the rest of the liquid, adding enough alkaline material to the sewage to raise the pH to over 11, thus destroying pathogenic and other bacteria in the sewage. Enzymes are released from the bacteria into the solution, lowering the pH of the sewage to between 3.5 and 6.5 by the addition of an acidic material. Any materials from the group consisting of starches, proteins, glycerides, and sugars are therefore enzymatically digested by the enzymes released. Seed bacterial, fungal or yeast organisms are then added to the sewage and assist in decomposing organic components. The sewage is acidified after substantial decomposition to kill the organisms developed from those seeded; dead organisms and other insoluble materials present are removed and the remaining liquid is neutralized.

*Patents, *Sewage treatment, *Organic compounds, *Inorganic compounds, *Bacteria, Metals, Biological treatment, Chemical precipitation, Acidity, Alkalinity, Waste water treatment

C257
WATER PURIFIED BY ELECTROFLOTATION FOR RAPID SEDIMENTATION AND CLEAN CLARIFIED WATER,

French Patent FR 2256-903. Issued September 5, 1975. Derwent French Patents Abstracts, Vol. W, No. 43, p D3, December 2, 1975.

A newly patented electroflotation process for treating waste water consists of passing it through an electroflotation station where small bubbles of O2 and H2 are produced electrolytically. As these bubbles rise they trap solids held in suspension or in emulsion. Large solid particles should be broken up before treatment. Chemical flocculants may also be added during electrolysis. Another type of equipment for this process is one in which the electroflotation station has one or more electrolysis grids, each with several spaced-apart anodes and cathodes. The latter process provides rapid sedimentation and is applicable to waters, such as those containing detergents, which are not easily purified by strictly biological methods.

*Patents, *Electrolysis, *Waste water treatment, *Bubbles, Treatment facilities, Equipment, Cathodes, Anodes, Flocculation, Sedimentation

Electroflotation, Physico-chemical treatment

C258
FLOTATION PROCESS AND APPARATUS,

Australian Patent 466,009. Issued October 16, 1975. The Official Journal of Patents, Trade Marks, and Designs, Vol. 45, No. 38, p 4251, October, 1975.

A process for the simultaneous separation of insoluble materials and oxygen from a contaminated oxygen-bearing liquid has been patented. A constantly changing body of contaminated oxygen-bearing liquid is established at a predetermined level and maintained in an enclosed tank. An overlying freeboard space is also established and is closed to the atmosphere. A substantially oxygen-free gas is continuously introduced into the freeboard space. Draft means extend downwardly from the free board space into the liquid body. The oxygen-free gas is drawn by way of the draft means into the liquid where it is dispersed. The gas bubbles through the liquid floating contaminants to the surface of the liquid while also displacing oxygen from the liquid. The floated contaminants and some of the displaced oxygen are discharged from the freeboard space. The residual treated liquid is also discharged.

*Waste water treatment, *Patents, *Equipment, Oxygen, Bubbles, Liquid wastes

Oxygen-free gas, Oxygen-bearing liquids

D001
REMOVAL OF ORGANIC MATTER BY ACTIVATED CARBON COLUMNS,

DeWalle, F. B., and Chian, E. S. K.

Illinois University, Urbana, Illinois,
Department of Civil Engineering

Journal of the Environmental Engineering Division, Vol. 100, No. EE5,
p 1089-1104, October, 1974. 6 fig, 2 tab, 32 ref.

Activated carbon treatment is conventionally used as a tertiary unit process following activated sludge treatment. However, it has been suggested that there is a significant leakage of organic matter through the columns and that activated sludge treatment adversely affects the removal of organic matter in activated carbon columns. An evaluation of the effect of activated sludge treatment on the compositon of organics in the effluent and this effect on subsequent activated carbon treatment was conducted. The composition of the organic matter in secondary effluent was studied as was the removal of these compounds in activated carbon columns. It was found that the major organic fraction adsorbed in activated carbon columns is a fulvic acid-like material with a molecular weight of 100 to 10,000. These compounds adsorb very well in activated carbon columns. Since they also represent a major fraction of the organic matter, adsorption in activated carbon columns was expected to increase with increasing degradation of the waste water. This phenomenon did occur in a study in which the TOC removal of a filtered mixed liquor by activated carbon increased in the succeeding compartments of a plug-flow activated sludge unit.

*Activated carbon, *Activated sludge, *Effluents, Sewage sludge treatment, Organic matter, Adsorption

Molecular weight, Activated carbon columns, TOC

D002
PLANT PERFORMANCE USING DISSOLVED OXYGEN CONTROL,

Roesler, J. F.

Advanced Waste Treatment Research Laboratory,
Environmental Protection Agency,
Cincinnati, Ohio,
Systems and Economic Analysis Section

Journal of the Environmental Engineering Division, Vol. 100, No. EE5,
p 1069-1076, October, 1974. 6 fig, 2 tab, 3 ref.

Control of the activated sludge process in waste water treatment plants improves process reliability and reduces treatment costs. Research has been conducted to assess the effectiveness of automatic controls, specifically that of the level of dissolved oxygen in the aerator. The oxygen supplied must be sufficient to meet needs of aerobic microorganisms, but there also is evidence that the set point and range of variability in DO level are critical in producing good quality effluent. A sewage treatment plant at Renton, Washington, was studied for its activated sludge process. The aeration tank in 1970-1971 was changed to automatic DO control system while the rest of the plant was still under manual control. During the switchover, manual DO performance data and automatic control data were compared. The automatic control maintained excellent operational performance. In the study of differences in loading, MLSS, suspended solids, and hydraulic flow, an improvement of 39l% was found. In addition, the plant efficiency in terms of BOD removal improved from 85% to 96%. Less problems were caused by filamentous bulking and sludge was easier to settle and handle.

*Dissolved oxygen, *Automatic control, *Manual control, *Waste water treatment, *Activated sludge, Sewage treatment, Treatment facilities, Sludge

Parameters

D003
RECYCLE SLUDGE TO FEED FARMS,

Schwing, J. E., and Puntennery, J. L.

Water and Wastes Engineering, Vol. 22, No. 9, p 24-27, 72, 74, 76, 78, September, 1974. 2 fig, 5 tab.

The Metro Denver Sewage Disposal District No. 1, Denver, Colorado, is expanding and developing a massive sludge disposal system. It will include long distance pumping of sludge slurry, subsurface injection, and air drying of the sludge for crop fertilization. On-site treatment of the sludge at the expanded facilities will consist of air flotation thickening of the waste activated sludge and anaerobic digestion of the combined waste activated and primary sludges for stabilization. Land incorporation of the sludge is currently practiced because it makes possible the reuse of a potentially valuable material for fertilization and eliminates the buildup of nutrients in the treatment system that results from the recycling of sludge. An environmental monitoring program tests core samples from the soil where the sludge is deposited for nutrients, metals, and coliform bacteria. Wheat is planted annually and used as pasture and hay for cattle. The expanded program will make sludge either in a dried or liquid state available to area farmers to use as fertilizer. An upper application limit will be set on each farmer's land depending on the crop grown. The expenditure for the proposed system compares favorably with the cost of the current system and also well with the cost of incineration.

*Sludge disposal, *Fertilization, *Nutrients, *Sewage treatment, Anaerobic digestion, Drying, Incineration, Municipal wastes, Application methods, Environmental effects, Irrigation practices, Organic matter

Denver, Colorado

D004
INVESTIGATIONS ON THE PRODUCTION OF HYGIENIC COMPOST FROM AIR-DRIED SEWAGE USING DIFFERENT ADDITIVES (Versuche zur Herstellung von hygienisch einwandfreiem Kompost aus luftgetrocknetem Faulschlamm unter Verwendung verschiedener Zusaetze),

Gaul, D., Strauch, D., Scholl, W., Mueller, W., and Miersch, K.

Umwelthygiene, Vol. 25, No. 10, p 227-236, 1974. 5 tab.

In the purification plant at Neureut, Germany, the waste water from the Karlsruhe population of 310,000 is purified, along with waste water from 250 industrial facilities. After mechanical separation the sludge is pumped into two digestion towers where it is stored. Liquid sapropel with a water content of 98% is then pumped into earth basins where part of the water is lost through normal drainage. When the water content reaches 75%, the sludge is lifted from the basins and placed in small piles for further drying. This material undergoes drying processes lasting roughly a year and is ground and composted in clumps measuring 2.0 m x 5.0 m x 1.5 m. Various types of typhus or paratyphus bacteria are added to each clump. Sulfite, lye, calcium cyanamide, bark from spruce and pine trees, poultry manure, pig manure, polystyrol flakes, and a substance called Biorott, made of vegetable origin and consisting 80% of various proteins, were all tested for their ability to produce a pathogen-free compost of dried sewage sludge. Biorott was found to be the most effective substance tested. It was also found that a pathogen-free compost could only be produced during the warm season between April and October, and that additives were necessary for this production.

*Water purification, *Sewage sludge, Waste disposal, Municipal wastes, Industrial wastes, Sludge drying, Bacteria

Germany, Compost, Biorott

D005
SOLVENT SOLVES DEWATERING,

Water and Wastes Engineering, Vol. 11, No. 9, p 84, September, 1974.

A new process using a solvent for dewatering of municipal and industrial sludge has been developed by the Boeing Aerospace Company of Seattle. It is designed to comply with strict water and air pollution control regulations and will allow the reclamation of oil and other sludge constituents. A solvent of the aliphatic amine family which becomes completely miscible below 20 C is mixed with the sludge. The resulting solution is a mixture of solid particles in a solution of water, solvent, oils, and fats. Solids are removed mecnanically; water and solvent are separated by heating the solution to above 40 C; and fats and oils are removed from the solvent by distillation. The solid portion is about 96% solid and will gather moisture in a normal atmosphere; the water is clear and sterile; and the oils and fats are of a commercially reclaimable grade. This technique is called the Boeing Extractive Sludge Treatment (BEST) and works equally well with highly organic or inorganic sludges. A theoretical savings of up to 90% in energy could be realized if BEST is used instead of some of the high temperature, brute force evaporation drying systems now used. Engineering cost analyses indicate an overall potential savings of 25% to 50% over present sludge dewatering methods.

*Sludge treatment, *Dewatering, *Separation techniques, *Solvents, Municipal wastes, Industrial wastes, Solubility, Energy, Costs

Boeing Aerospace Company, Boeing Extractive Sludge Treatment, Seattle, Washington

D006
EFFLUENT TREATMENT EQUIPMENT,

Processing, Vol. 20, No. 11, p 55-56, 1974. 1 fig.

Equipment is described which emphasizes the reduction of costs of effluent treatment. With new legislation on water quality of waste discharge streams, efficient treatment is necessary as well as some recovery of waste streams. A system for separating oil from washwater was designed to suit specific effluents and the level of purity required by individual regulations. William Boulton, Ltd. packaged a system which includes civil engineering and connection of the system to existing drains; the cost of these are about 40 percent less than existing systems. A small scale interceptor for lighter-than-water pollutants has been manufactured by Conder Hardware Ltd. and offers easy installation and straightforward operation. Its tanks are made of glass-reinforced plastics and PVC connecting pipes and ring seal sockets. Other systems described for effluent treatment are used for solids removal. Two new pieces of equipment are the Accelerator, from the G. F. Dickson Environmental Engineering Ltd. and the Flockation process from Neckar Water Engineering Ltd. These operate by coagulation followed by floc removal and save a great deal of time, space, and capital costs over conventional processes. Sludges produced by water treatment systems can be dewatered by a Winklepress, designed by Simon-Hartley Ltd. and Gebr. Bellmer KG.

*Equipment, *Effluents, Waste treatment, Water treatment, Sludge, Costs, Oil, Water quality, Legislation

Waste discharge, Effluent treatment, Cost reduction

D007
USING SLUDGE, OIL, AND WATER SEPARATION FOR RECYCLING WATER,

Water and Sewage Works, Vol. 121, No. 11, p 41-42, November, 1974.

The treatment and recycling of water, including the reclamation of consitituents which can be reused, can be a contributing factor in energy supply and is becoming increasingly important. A system has been designed, with PAI and EPA specifications in mind, to reclaim oil and sludge constituents. It is the Endress+Hauser's Vibratrol, a submergible vibrating tuning fork level control. It is an automatically-controlled separator system that can be buried in the ground. The influent is collected and solids, oil and retreatable water are separated, reclaimed, totalized and treated continuously. Level control sites are the sludge/water interface, the oil level, the water level and water outflow totalization. The E+H Vibratrol vibrates in air, water, or a similar substance. When the tuning fork is contacted by sludge or solids at a predetermined level, it activates an agitator and pump for reclamation of sand, clay and gravel. The Vibratrol consists of a pair of piezo ceramic crystals mounted permanently within the tuning fork assembly. The piezo-electric principle is applied in a closed loop: power is supplied to a crystal which then oscillates, the oscillation is picked up by the tuning fork, increased to its natural resonant frequency, ending in a sympathetic, harmonic vibration which drives the second crystal to provide power output.

*Waste water treatment, *Separation techniques, *Reclaimed water, *Oily water, Water reuse, Water treatment, Oil wastes, Sludge, Oil

Endress+Hauser's Vibratrol, Oil reclamation

D008
BIODEGRADATION OF NTA DETERGENTS IN A WASTEWATER TREATMENT SYSTEM,

Renn, C. E.

Johns Hopkins University, Baltimore, Maryland

Journal of the Water Pollution Control Federation, Vol. 46, No. 10, p 2362-2371, October, 1974. 3 fig, 2 tab, 8 ref.

A practical field test was performed to determine the biodegradability of trisodium nitrilotriacetate (NTA) in a domestic waste water treatment system. The test was conducted over a three year period at the Elm Farm Mobile Home Park near Woodbridge, Va. The waste water treatment plant consisted of a 25,000 gallon mixed liquor basin, aerated and mixed by an aerator driven by two 2.5 hp compressors. The mixed liquor is displaced to a conical clarifier through a submerged line to the clarifier's stilling well. The treated waste water is released to a stream; the waste sludge is disposed of on tilled land. The first release of the detergent to the community resulted in two findings: the total phosphorus in the treated waste water dropped from 18 to 20 mg/liter to 10 mg/liter in the first week and continued downward through the following weeks to a steady low of around 8 mg/liter; and, the community used much more of the detergent than was expected. The initial results indicated that the plant was unable to acclimate itself to shock concentrations of NTA. The detergent was again released to the community and the phosphorus and NTA levels were monitored. The results of this part of the study indicated that the plant influents had acclimated to 40 gm/liter NTA and consistently yielded effluents in the range of 0.3 to 1.0 mg/liter NTA. Good performance of the system was also shown by MBAS concentrations of less than 0.5 mg/liter and DOC reductions of 70 percent in the effluent.

*Waste water treatment, *Detergents, *Phosphates, *Domestic wastes, Nitrilotriacetic acid, Water pollution sources

*Trisodium nitriloacetate

D009
CONTAINMENT, COLLECTION AND RECYCLING OF OILY WASTES,

Dalton, T.

Metropolitan Petroleum Company

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 91-97. 1 fig, 1 tab.

To help in explaining some of the options that are available to plant maintenance and engineering personnel, the basic nature of the problem of containing, collecting and recycling oily wastes is reviewed. Of primary concern is the determination of an oil balance for each specific plant location. A waste oil analysis should be performed. An oil spill contingency program should be devised for those plant situations where emergency spills may occur. Spills are broadly grouped into two categories: land spills and waterborne spills. A description of Ekoperl and Conwed Sorbers are given; these can be used for containing and absorbing spills on land. MP Boom specifications are given; this can be used for containing waterborne spills. The waterborne spills, after they have been contained, can be removed by appropriate skimming devices, absorbent materials, or manual skimming. All plants should have the supplies and equipment necessary for combating oil spills, such as containment booms, absorbents, and skimming devices, readily available to all plant personnel in the same way fire equipment is available. If the collected oil is of high quality and expensive, it should be placed in a segregated system and treated either chemically or mechanically for recycling and reuse. If the oil is of poor quality and inexpensive, it can be mixed with fuel oil and removed through the combustion process.

*Oily water, *Oil wastes, *Recycling, *Oil spills, *Water pollution sources, Oil pollution, Water pollution, Industrial wastes, Pollution abatement, Waste treatment

Waste oil recycling

D010
PORT RECEPTION AND TREATMENT FACILITIES FOR OILY WASTE FROM VESSELS,

Armstrong, A. S., and Randall, K. J.

Maritime Administration

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 149-184. 2 fig, 10 tab, 12 ref.

An outline of the scope of the oily waste problem is given in terms of quantifying the waste oil volumes which may be expected by U.S. ports and the various feasible methods for removing oily waste from vessels and disposing of the treated water and recovered oil. Also discussed is the economic viability of waste oil recovery disposal operations from vessels, and the roles of the various government agencies in preparing for shoreside handling of vessel-generated oily wastes. Conclusions and recommendations are presented in regard to collection/separation entrepreneurial potential and oil processing entrepreneurial potential. The cost associated with collection, treatment, and disposal of oily waste from vessels will eventually lead to an increase in ocean steamship freight rates or required freight rate. The role of the Federal Government should be to facilitate the growth of current oily waste facility and service capabilities to meet the requirements of maritime pollution abatement. The role of state governments is interrelated with Federal grant programs. Local government roles may be investments by communities in the construction and ownership of treatment facilities which are then operated by entrepreneurs. Local governments could also be responsible for the enforcement of bans on certain kinds of waste disposal practices.

*Oily water, *Waste disposal, *Ships, *Oil wastes, Water pollution sources, Waste treatment, Governments, Governmental interrelations, Recycling, Pollution abatement

Ports

D011
OIL CONTAMINATED WATER RECYCLING SYSTEM,

Overfield, J. L., and Richard, J. W.

Pollution Abatement Research

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 289-294.

The results of a program to demonstrate an oil contaminated water recycling system which will remove oil from contaminated water to ten ppm and remove solids are discussed. The system consists of a filter/coalescer, a solids cleaner, and accessories. The filter/coalescer unit is the main component and is composed of the following principal sections: filter/coalescing cartridges; a backflush system; and, automatic oil discharge system for separated oil. The filter/coalescer unit in this system differs from other similar units in that the automatic backflush mode greatly reduces possible solids plugging of the cartridge; the backflush mode can be operated while the unit is in full service; the unit is mounted horizontally rather than vertically; and, the unit can be used on shore, on board ship or submerged. The water, oil, and solids are first sent into the filter/coalescer unit. The solids are captured in the core of the cartridges and the water and oil pass through the cartridges to the tank of the unit. The oil collects in the oil boot and the water flows out the clean water outlet. The solids are backflushed to the solids cleaner where the oil is removed from them. Clean water and solids are discharged and the oily water is returned to the filter/coalescer unit. Final testing of the filter/coalescer unit was performed using fresh water and crude oil, simulated sea water and crude oil, and offshore production brine water with oil and production chemicals.

*Oily water, *Recycling, *Waste water treatment, *Equipment, Separation techniques, Oil-water interfaces

Filter/coalescer unit

D012
COOPERATION COMBATS OIL SPILLS IN NORTH CAROLINA,

Fuel oil and Oil Heat, Vol. 34, No. 2, p 24-25, February, 1975.

Oil spill control in Randolph County, North Carolina has been incorporated into their county Rescue Squad operation. The Randolph County Oil Dealers Association decided in the spring of 1974 to plan for protection against major oil spills, and that members should cooperatively purchase pollution control equipment. Out of 29 area fuel dealers, 25 contributed to the project. The members have purchased a trailer with boom, skimmer, and oil absorbent, costing a total of $8000. A test using styrofoam pieces to represent oil was demonstrated for the public on Dula Lake; the entire clean-up was performed by rescue squad members, with dealers assisting only. The Ashe-Rand Rescue Squad has trained 25 of its members specifically for the use of oil spill containment equipment. In the event of a spill, the dealer responsible for the accident will pay for materials used, such as absorbent foam or fuel.

*Oil spills, *Water pollution control, Costs, Equipment, Planning, North Carolina

Oil boom, Oil skimmer, Oil spill protection

D013
CHEMICALS REDUCE SYSTEM ODORS,

Fenman, A., and Borlase, W. J.

City of Winnipeg Waterworks,
Winnipeg, Canada,
Waste and Disposal Division

Water and Pollution Control, Vol. 113, No. 1, p 29, 33, January, 1975.

The sewage system of the City of Winnipeg, Canada accepts wastes from one major oil refinery and three meat packing plants at one of its lift stations. Upstream from the lift station, the combined industrial and municipal wastes have been causing sewer odors. Treatment of these odors in the past has been by chlorination. However, with recently increasing chlorine costs, possible difficulties in obtaining chlorine, and danger involved in its storage and use, alternative treatment methods have been investigated. In 1974, a product called Micro-Aid was tested over a seven-week period during the hottest summer months. The product is extracted from Yucca plants and consists of 10% natural saponins extracted from plants, 90% inert water, and 150 ppm of copper as a preservative. Five test sites were sampled for atmospheric temperature, sewage temperature, dissolved sulfide, atmospheric sulfide, pH, and general odor. Three periods of study compared Micro-Aid, chlorine, and no odor control treatment. Overall reduction of odors was found with Micro-Aid but chlorine provided better immediate reduction in atmospheric and dissolved sulfide levels. Micro-Aid does not reduce levels of dissolved sulfide within the sewage, but acts as a surfactant, reducing the surface tension of the sewage and keeping the hydrogen sulfide in solution. A one-year trial of this product for 1975 has been proposed. Although its costs are 25% higher than chlorine, operational and safety benefits may warrant its use.

*Odors, *Sewage treatment, Municipal wastes, Industrial wastes, Oil industry, Canada, Chlorine, Pilot plants, Costs

*Micro-Aid

D014
THE DAVY JONES GARBAGE DUMP,

Cox, G. V.

Raytheon Company,
Portsmouth, Rhode Island

Environmental Science and Technology, Vol. 9, No. 2, p 108-111, February, 1975.
6 tab.

Ocean disposal of municipal and industrial wastes has been strongly opposed, particularly by residents of Delaware, Florida, and New York. Recent legislation, such as the Marine and Sanctuaries Act of 1972 (P.L. 92-532) is discussed. In the fall 1972, an International Convention on the Prevention of Marine Pollution by Dumping of Wastes was held which specified certain materials which could not be released and restrictions on the quantities of other materials. The process of application and granting of permits to release wastes to marine waters is complicated, and involves regional jurisdiction of the EPA. Ocean dumping criteria include materials which are absolutely prohibited, such as high-level radioactive wastes, biological, chemical or radiological warfare agents, or persistent inert synthetic or natural floating materials; materials prohibited in other than trace quantities, such as mercury, cadmium, organohalogens, and oils and greases; strictly regulated materials, including petrochemicals, organic chemicals, and organic processing wastes, inorganic processing wastes, biocides, immiscible materials, and other wastes which might cause hazard to navigation. Types of ocean dumping permits are detailed. The pollution and ocean impact by ocean outfalls discharging sludge is also compared with potential hazards of ocean dumping of wastes.

*Oceans, *Waste disposal, *Municipal wastes, *Industrial wastes, Pollution abatement, Radioactive wastes, Organic compounds, Waste discharges, Water pollution effects, Environmental effects, Legislation

Ocean disposal, Petrochemicals, Heavy metals

D015
DESIGN FOR SOLVENT RECOVERY,

Drew, J. W.

Chem-Pro Equipment Corporation,
Fairfield, New Jersey

Chemical Engineering Progress, Vol. 71, No. 2, p 92-99, February, 1975. 11 fig, 6 tab, 4 ref.

A review is given of the necessary steps to establish a system of reusing solvents from exhaust air and waste water in terms of costs, shortages, and pollution problems. Recovery involves removal of the solvent or collection of a liquid solvent contaminated with chemicals, dirt, and other solvents. The collected solvent must be purified, usually by distillation, and sometimes additionally by extraction. Flowsheets illustrate alternative recovery processes. While direct distillation of solvents from waste waters is possible, it is often more economical to do preliminary extraction with a water-immiscible solvent and then separation from the solvent by distillation. Commercial applications of this method are the removal of traces of phenol from waste water and the recovery of acetic acid from dilute aqueous solutions. The economic specifications for recovered solvents are: water content of the solvent, 0.05-0.50%; cross mixing of solvents, 0.5-5.0%; and organic content of the waste water, 10 to 100 ppm. Design optimization for a test system has been computed. Costs for any application are correlated with size, material of construction, and increases due to inflation. Safety and experience factors should also be included among design criteria.

*Reviews, *Costs, *Design criteria, Water pollution control, Phenols, Solvents

Waste reuse

D016
WASTE-HEAT STEAM RUNS EVAPORATIVE WATER PURIFIER,

Chemical Engineering, Vol. 82, No. 6, p 34, March 17, 1975. 1 fig.

An advanced method of waste water treatment has been developed by the Aluminum Company of America. Called the Alcoa Thermopure Process, this method uses waste heat and is related to previous environmental work in desalination. Low-pressure steam (5-10 psi) is generated by waste heat from various sources, such as furnace stacks. Wastes are concentrated by this process and can be recycled to recover chemicals and oils. Full-scale plant tests have used waste heat to treat effluent from a rolling mill. Earlier bench-scale and pilot plant tests showed that the process is effective for concentration of pollutants from sewage, suspended or emulsified oils, cooling towers, and chemical cleaning solutions. The basin unit operation employed is evaporation. Waste is pumped into the top of a vessel and dispersed by pressurized air; the mixture of air and waste water is then heated by hot air and water vapor. Steam introduced into the lower part of the vessel supplies the heat. Humidified air separates the concentrated liquid wastes and is conducted up a bypass line to tube exteriors in the upper part of the vessel. Air cools while it heats incoming waste water-air mixtures. Vapor condenses simultaneously to deionized-quality water. The concentrated liquid is discharged to a tank where wastes can be mechanically separated; if recycling is to be used, mixed wastes are then recirculated.

*Waste water treatment, Sewage, Industrial wastes, Oils, Chemicals, Water purification

Waste heat, Steam

D017
OZONE TECHNOLOGY GAINS SUPPORT,

Canadian Chemical Processing, Vol. 59, No. 1, p 19-22, January 1975. 2 fig.

A state-of-the-art summary is given for current ozone uses and technology in Canada. Both Metro Toronto and Metro Montreal are installing large ozone plants for municipal water treatment. Montreal is building the world's largest ozone potable water treatment facility, while Toronto is installing ozone units for sewage treatment at two stations to eliminate odors. Most suppliers of ozonators to Canada are now from France and the United States; these corporations are discussed. Canadian industrial applications of ozone include its use in successfully removing phenol from petroleum refinery waste water and its use in treating kraft mill effluents in the paper industry. For such technology, the greatest expenditure is in ozonation equipment. Ozone generator outputs vary and costs are related to power consumption. Advantages of ozone both for industrial water treatment and for potable water are discussed. Chlorine is more prevalent in North America, while ozone is used widely in Europe. Specific water purification systems with ozone are cited in Long Island, New York, Indiantown, Florida, and Paris, France, and are compared with Canadian cities.

*Ozone, *Canada, *Water purification, *Potable water, Industrial wastes, Pulp and paper industry, Oil wastes, Municipal water, Reviews, Chlorine, Odors

Montreal, Toronto, Quebec

D018
CATALYTIC OXIDATION OF PHENOL IN AQUEOUS SOLUTION OVER COPPER OXIDE,

Sadana, A., and Katzer, J. R.

Delaware University,
Newark, Delaware,
Department of Chemical Engineering

Industrial and Engineering Chemistry: Fundamentals, Vol. 13, No. 2, p 127-134, 1974. 9 fig, 7 tab, 51 ref.

Waste water streams, particularly from the chemical processing industry, contain high concentrations of dissolved organics, particularly phenols. These effluent materials are difficult to oxidize biologically, but must be adequately treated to meet demands for improved water quality. A model reaction was studied using aqueous-phase catalytic oxidation of phenol over supported copper oxide to provide design information on catalytic oxidation as a waste water treatment technique. Pressure in an autoclave of between 369 K and 473 K and a batchwide mode at atmospheric pressure and 373 K were used. The reaction was seen to undergo an induction period and a transition to a much higher, steady-state activity regime. The reaction was first order with respect to phenol in both regimes, but oxygen dependency decreased from first to one-half order in shifting regimes. The rate was proposed to involve a free-radical mechanism as the rate exhibits a pronounced induction period and an unusual dependence on catalyst loading. The catalyst greatly enhanced the rate and additionally greatly affected the production distribution observed.

*Phenols, *Waste treatment, *Industrial wastes, Oxidation, Chemical industry, Organic compounds

*Catalytic oxidation

D019
SEPARATION OF PHENOL FROM WASTE WATER BY THE LIQUID MEMBRANE TECHNIQUE,

Cahn, R. P., and Li, N. N.

Exxon Research and Engineering Company
Linden, New Jersey

Separation Science, Vol. 9, No. 6, p 505-519, 1974. 7 fig, 3 tab, 4 ref.

A number of systems have been compared for the removal of phenols from waste waters. The liquid membrane emulsion technique, which involves either oil-in-water or water-in-oil emulsions is described as to its performance in small scale laboratory tests. The impurity in the waste water, such as phenol, permeates across the oil membrane in its undissociated form and is then neutralized by the strong caustic or acid inside the aqueous droplets within the emulsion, thus preventing its escape back out into the waste water. A single-stage installation together with make-up, recycle, and disposal is described. Mathematical relationships are derived for the theoretical distribution and for the rate of permeation of phenol into an emulsion. The method is particularly useful where other techniques fail due to the presence of interfering substances, or very high or very low pH.

*Phenols, *Waste water treatment, Emulsions, Oil, Mathematical models, Laboratory tests, Membrane processes

Liquid membrane emulsion

D020
RUNOFF OF OILS FROM RURAL ROADS TREATED TO SUPPRESS DUST,

Freestone, F. J.

Edison Water Quality Research Laboratory,
Environmental Protection Agency

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Incorporated, Washington, D. C., p 375-393. 6 fig, 7 tab, 3 ref.

Waste crankcase oils, as applied to rural roads in the United States for the purpose of dust control contain about one percent by weight of lead compounds. In Hunterdon County, New Jersey, where roads are oiled twice yearly, two rural roads were examined to determine whether or not oil leaves the roads. Of the oil applied, it was estimated that about one percent remains in the top inch of road surface material and that oil penetration below the top inch is minimal. Oil may leave the road during wet weather by flotation from wet road surface material; lead also leaves the road surface with runoff. A considerable amount of lead--about 200 mg/kg--may be associated with dust particles on the road and may be carried by winds to contaminate crops and fields adjacent to the roads. It is not possible to quantify the amount of oil runoff. However, the ecological consequences of runoff oil and its accompanying heavy metals such as lead need to be studied further.

*Oil, *Rural areas, Metals, Lead, Runoff, Roads

Oil runoff, Lead pollution

D021
EXTRACTION OF PETROLEUM HYDROCARBONS FROM OIL-CONTAMINATED SEDIMENTS,

Walker, J. D., Colwell, R. R., Hamming, M. C., and Ford, H. T.

Maryland University,
College Park, Maryland,
Department of Microbiology

Bulletin of Environmental Contamination and Toxicology, Vol. 13, No. 2, p 245-248, 1975. 2 tab, 4 ref.

The degradative capabilities of naturally-occurring microorganisms in Chesapeake Bay are assessed by sampling on a regular basis. One area, that of Colgate Creek, is contaminated with petroleum compounds, including cosmoline (a wax used to protect automobiles during Atlantic transport), kerosine (used to wash wax from the automobiles), motor oil, and tanker fuels. A study was conducted to determine whether or not a correlation exists between numbers of petroleum-degrading microorganisms with amount of petroleum-like material routinely extracted from sediment. In addition, a comparison is made of several methods and solvents for extraction of estuarine water and marine sediments. Comparison of the amount and proportional representation of each component extracted, as determined by mass spectrometry, indicated that the material contained the hydrocarbons found in petroleum. The most effective solvent found for the extraction was benzene or benzene-methanol azeotrope. A method of reciprocal shaking, employing benzene as the solvent was thus determined to be the most efficient extraction of petroleum hydrocarbons from both estuarine and marine sediments.

*Oil, Solvents, Marine microorganisms, Water pollution control, Biodegradation, Estuaries, Separation techniques

*Petroleum, *Hydrocarbons, *Benzene

D022
SEWAGE TREATMENT METHOD UPS CAPACITY,

Chemical and Engineering News, Vol. 52, No. 33, p 6-7, August, 1974.

Lathrop Laboratories, Fresno, California, has developed a sewage treatment process that uses a newly developed bacterial isolate and the sewage lines themselves as partial digesters. The bacterial isolate is not a normal constituent of feces. However, it multiplies in the anaerobic environment of most sewage lines and degrades waste without producing offensive odors. Tests of the process showed that it can achieve a great reduction in BOD, ammonia and nitrates concentration and hydrogen sulfide levels. The cost of treating one mgd was about $400 per month. The bacteria were developed from normal "earth bacteria" and present no health or safety problems. They were grown in 2000 gallon nonpressurized tanks and metered into the sewage lines in appropriate amounts. The bacterial isolates could also be applied to rivers, lakes, and ponds, using crop dusting aircraft, to improve the ability of these bodies of water to assimilate sewage and other effluents.

*Bacteria, *Sewage treatment, *Sewers, *Digestion, Anaerobic conditions, Anaerobic digestion, Biochemical oxygen demand, Nutrient removal, Pipelines, California

D023
AUTOMATIC CHAMBER FILTER PRESSES FOR WASTEWATER TREATMENT (AUTOMATISCHE KAMMERFILTERPRESSEN ZUR ABWASSERBEHANDLUNG),

Galvanotechnik, Vol. 65, No. 7, p 612, July, 1974. 1 fig.

Netzsch type chamber filter presses for the dewatering of industrial and municipal sewage sludge are described. The filter presses are designed for filter pressures of up to 15 atm, and are also available in fully automatic design. With a filter surface of 4 sq m per chamber, one filter press can accomodate up to 120 chambers. The filtrate obtained is clear and can be discharged into the sewer system, while the filter cake has a dry content of 40 percent.

*Waste water treatment, Automation, Industrial wastes, Municipal wastes, Sewage sludge, Design, Filters

*Filter presses, *Filter cakes

D024
GET READY FOR UNI-FLOW FILTERS,

Camirand, W. M., and Popper, K.

National Regional Research Laboratory,
U. S. Department of Agriculture,
Berkely, California

Water and Wastes Engineering, Vol. 11, No. 10, p 31-34, October, 1974. 4 fig, 3 tab.

The uni-flow filter for the physical-chemical treatment of municipal waste water is described. This filter was invented as an inexpensive alternative to a settling tank for concentration of calcium hydroxide and magnesium hydroxide slurries in connection with an ion exchange desalination process. It has been tested as a solid liquid separator in a municipal sewage treatment scheme using modular mobile equipment. The filter itself is a vertical cloth tube between four and twenty feet long, which might be seen as a settling tank with permeable canvas walls. Input is at the top and a sludge discharge valve and a filtrate collector are located at the bottom. Solids are retained on the inside of the porous tube. Hydrostatic pressure forces the filtrate through the porous walls, and gravity effects the settling of solids within the tube. The simplified steps of the process are: comminution; liming; solid liquid separation; carbonation; additional solid liquid separation; and activated carbon treatment. Carbonation may be supplanted by ion exchange and the activated carbon treatment by reverse osmosis. In a 32-hour filtration of lime-treated municipal waste water with the uni-flow filter, biochemical oxygen demand was reduced by 78%, and suspended solids and E. coli were cut by 100%. Dissolved oxygen was increased from one ppm to 7.7 ppm.

*Filters, *Municipal wastes, *Waste water treatment, Settling, Lime

*Physical-chemical treatment, Uni-flow filter

D025
GERMFREE WATER PRODUCED BY OZONIZERS (KEIMFREIES WASSER DURCH OZONANLAGEN),

Blankenfeld, D.

CZ Chemie-Technik, Vol. 1, No. 11, p 527-528, 1972.

The possible uses of ozone in water preparation are outlined, and preparation of potable water from percolated river water by ozonization is described. Ozone can be used to kill germs, to improve the organoleptic properties, and to oxidize iron, manganese and organic compounds in water. In the Wittlaer waterworks which prepares drinking water from polluted Rhine water, ozone is generated from liquid oxygen, and is used in a closed cycle. Ozone is contacted with a partial stream which is later united with the raw water to avoid bubbling. In the waterworks of the city of Ulm, which extracts water from the Danube and other rivers, ozone is generated from air in a fully automatic ozonization plant. Quantitative oxidation of iron, manganese and phenols, and total destruction of the germs were observed along with a very significant improvement of the organoleptic properties of the drinking water. The activated charcoal consumption for the subsequent final filtration decreased from 30-40 to 3 g/cu m by the use of ozonization.

*Ozone, *Potable water, Water treatment, Municipal water, Public health, Rivers, Viral removal

River water, Ozonizers

D026
SLUDGE DEWATERING,

Barnhill, K. G.

Industrial Water Engineering, Vol. 11, No. 5, p 21-24, September/October, 1974.

A survey taken by the Washington Aqueduct Division reported that 57 of the 100 largest water treatment plants in the United States disposed of their sludges and backwash water to the nearest source of surface water. Waste flows from municipal waste water and water plants require treatment before final disposal. Optimum final disposal must be preceded by one or more dewatering steps. The degree of dewatering and the need for digestion are determined by the method of disposal, such as landfill, incineration, lagooning, or barging to sea. In choosing the optimal technique of dewatering, the following factors should be considered: availability of prior applicable experience; equipment operation, such as manpower requirements, operator skill needed, controls, hazards, and dependability; operating and capital costs; implementation problems, such as odors or chemical handling; and regulatory rules for pollution control. The techniques detailed included sludge dewatering by centrifugation, vacuum filtration, gravity sludge dewatering, sludge concentration, pressure filtration, and use of the belt filter press or the vertical screw press.

*Waste disposal, *Dewatering, Costs, Equipment centrifugation, Filtration, Sewage sludge treatment

*Sludge dewatering

D027
NEW SERIES OF STANDARD DESIGNS OF BIOLOGICAL WASTE WATER TREATMENT WITH CAPACITIES OF 100, 200, 400, and 700 CU M/DAY,

Sirota, M. N.

Vodosnabzheniye i Sanitarnaya Teknika, No. 7, p 12-14, 1974. 2 fig, 1 tab.

Standardized biological waste water treatment plants with unit capacities of 100, 200, 400, and 700 cu m/day, intended to serve communities with 300 to 5000 inhabitants, are described. These waste water treatment plants are designed for municipal and similar effluents with relatively low BOD5 which is reduced to 20 to 25 mg/liter as a result of the biological purification. The principle of prolonged aeration or full oxidation is employed to combine biological purification with partial mineralization of the sewage sludge. The waste water to be treated is aerated by means of mechanical or pneumatic aerator for one day, after which the sludge is settled and subsequently dried in beds, and the purified water is discharged into the recipient. While mechanical aeration is less economical than pneumatic aeration, it is superior to the latter in efficiency in the case of permanent high pollutant loads.

*Biological treatment, *Waste water treatment, *Municipal wastes, Biochemical oxygen demand, Aeration, Pollution abatement, Design criteria

Mechanical aeration, Pneumatic aeration

D028
WASTES MAY NOT BE A TREAT FOR PRETREATMENT,

Chemical Week, Vol 115, No. 15, p 27-30, October 9, 1974.

While joint treatment of municipal and industrial wastes has been strongly advocated, sufficient pretreatment of chemical wastes is necessary. The problems associated with combining municipal and organic-chemical (industrial) wastes are discussed. For example, introduction of a readily degradable organic waste water to an activated sludge plant may require readjustment of organic loading. In another case, while the BOD in domestic sewage is primarily suspended and colloidal, and thus insensitive to temperature, soluble industrial waste waters require a biological removal mechanism that is affected by temperature, resulting in a need for adjustment for low winter temperatures. Levels of necessary pretreatment are higher for discharge of industrial wastes to a physical-chemical treatment plant than to a biological waste treatment plant. Types of possible pretreatment to facilitate joint municipal-industrial plants include evaporation, addition of lime, freezing, or membrane processes, as well as a recommendation that organic chemical manufacturing processes be modified to cut down on the quantity of waste water and treatment inhibitors. While some organic chemical waste streams can never be treated together with municipal wastes because of their high toxicity levels, more joint treatment may be possible if organic chemical plants implement adequate pretreatment plans.

*Chemical wastes, *Pre-treatment, Biochemical oxygen demand, Municipal wastes, Biological treatment

*Combined municipal-industrial wastes, Organic chemical wastes

D029
VIRUS INACTIVATION DURING TERTIARY TREATMENT,

Wolf, H. W., Safferman, R. S., Mixson, A. R., and Stringer, C. E.

Texas A&M University,
College Station, Texas

Journal of the American Water Works Association, Vol. 66, No. 9, p 526-531, September, 1974. 2 fig, 11 tab, 14 ref.

Use of a clarifier in both alum and lime modes is detailed, as applied to viral-removal efficiency. Recent calculations show the virus hazard to be about 10 tissue culture infectious doses/ml (TCID50/ml) of enteric viruses in waste water, a relatively low value. Tertiary treatment processes were studied at large-scale pilot plants. It was demonstrated that virus removals from secondary effluents by alum coagulation-sedimentation and coagulation-sedimentation-filtration processes are essentially the same as those found in smaller-scale studies. Removals of bacterial virus as high as 99.845 percent for coagulation-sedimentation and 99.985 percent for coagulation-sedimentation-filtration were found with an Al to P ratio of seven to one. High lime treatment of secondary effluents achieved very high degrees of virus removal; the percentage has not yet been quantified. Microbiologically, the results of these studies suggest that the high lime process should be applied to the disinfection of waste water.

*Alum, *Lime, *Tertiary treatment, *Viruses, *Disinfection, Waste water, Sedimentation, Coagulation, Filtration, Effluents

Secondary effluents, Viral removal

D030
MUNICIPAL WASTEWATER BACTERIA CAPABLE OF SURVIVING CHLORINATION,

Davis, E. M., and Keen, S. R.

Texas University, Houston, Texas,
School of Public Health

Health Laboratory Science, Vol. 11, No. 4, p 268-274, October, 1974. 4 fig, 11 ref.

It was questioned whether certain municipal waste water bacteria may be capable of surviving chlorination and whether or not chlorination is an effective enough treatment method, in terms of public health. Selected diagnostic biochemical media were used to identify some of the bacterial species which survive chlorination of secondary treated municipal waste water and those species which demonstrated an ability to reestablish their populations with time. Fecal coliform, fecal streptococci, and total coliform were enumerated with further differentiation into lactose non-fermenters within and outside the family Enterobacteriaceae. It was determined that the vast majority of the waste water species which reestablished their populations within twenty-one days following chlorination were lactose non-fermenters not included in the Enterobacteriaceae. Many of those could be pathogenic under their own required conditions, and may constitute a threat to public health in receiving waters designated for contact recreation.

*Chlorination, *Municipal wastes, *Pathogenic bacteria, *Bacteria, Public health, Coliforms, Municipal water

D031
APPARATUSES AND PROCESSES FOR MODERN WASTE WATER TREATMENT AND SEWAGE SLUDGE DISPOSAL (GERAETE UND VERFAHREN NEUZEITLICHER ABWASSEREINIGUNG UND KLAERSCHLAMMBESEITIGUNG),

Karnovsky, F.

Energie und Technik, Vol. 26, No. 6, p 140-144, June, 1974.

Modern equipment and processes for waste water and sewage sludge treatment are described. Trouble-free operation of trash racks is possible by new automatic counterflow trash racks. Modern sand sifters remove most of the organic matter from and dehydrate sand effectively. The material retained by trash racks is pressed for dehydration and subsequent incineration as such wastes can not be safely disposed of on sanitary landfills. The biological treatment stages operate with high-efficiency surface aerators or compressed-air aerators which also provide for intense turbulence and mixing of the waste water with air. Percolating bodies based on PVC, such as Flocor and Hydropak, are commercially available. Sludge dehydration is carried out mainly by vacuum filtration, pressure filters, filter presses for continuous or batch operation, or by centrifuges. The dehydration requires thermal or chemical conditioning to improve dehydration and increase homogeneity. Digested sludge is pasteurized prior to application to an agricultural land.

*Waste water treatment, *Sewage sludge, *Automation, Waste disposal, Filtration, Dehydration, Organic matter, Sewage treatment, Centrifugation

*Polyvinyl chloride, Flocor, Vacuum filtration, Pressure filters, Percolation

D032
DESIGN BASIS FOR THE ROTATING DISC PROCESS,

Steels, I. H.

CJB Developments, Limited,
Environmental Division

Effluent and Water Treatment Journal, Vol. 14, No. 8, p 431-432, 436-437, 439, 441-445, August, 1974. 3 fig.

The Rotating Disc Process is a high rate biological stage of a conventional sewage treatment plant, used for treatment of sewage as well as industrial effluent waste water. The disc stage is normally preceded and followed by sedimentation and clarification tanks, of designs appropriate to their respective plant sizes. The mechanical arrangement and operational process of a rotating disc plant are similar to those of ordinary percolating filters and activated sludge plants. A biological growth similar to that found in percolating filters grows on the surface of the discs of the Rotating Disc Plant. A freely circulating biomass is found in the plant's troughs, which aids in the biological treatment of waste water. Turbulence is created by the rotating discs to keep the biomass in motion. An increase of disc rotation speed reduces the thickness of biomass growing on the discs and limits the role of the disc to that of introducing oxygen to the biomass present in the troughs. With the system of rotating discs, it is possible to introduce the biomass alternately into the waste water and the air without it being necessary to move the waste water or the air. Thus biological treatment is possible with a reduction in energy, since only the biomass of the plant must be moved. One application of the rotating disc plant is in secondary treatment of domestic sewage from single houses or very small communities. Septic tanks receiving such wastes have been equipped with packaged rotating disc plants inclusive of their own final clarification sections.

*Biological treatment, *Sewage treatment, Sedimentation, Clarification, Activated sludge, Percolation, Secondary treatment, Waste water treatment, Biomass, Design criteria

D033
AN OUTLINE SCHEME FOR RE-USE OF MOGDEN SEWAGE EFFLUENT,

Fish, R., and Savage, J.

Robert Fish and Partners
Consulting Engineers,
London, Great Britain

Water Services, Vol 78, No. 943, p 300-303, September, 1974. 3 fig.

Water reuse by effluent discharges to rivers is a common practice in water conservation in England and Wales. It was suggested that the River Thames might be used to deliberately arrange the reuse of effluents discharged to estuaries and tidal waters. The present outfall from the Mogden Sewage Purification Works discharges to the tideway at Teddington Weir, and might be reused if sewage effluent were diverted inland. A summary of how this Mogden effluent could be returned inland with a scheme for maximun extent and flexibility is given. Quantitative considerations such as volume of effluent, and qualitative considerations, such as meeting required water quality discharge to the Grand Union Canal system, are discussed. It was suggested that a flexible scheme using up to 60 mgd of the effluent from the Mogden sewage works could be based on the use of the Grand Union Canal and its branches as a main aqueduct to convey reclaimed effluent to points of demand. The scheme could provide 50 mgd raw water for public supply at a capital cost of between 60,000 and 70,000 pounds per million gallons, as well as providing water for second class industrial supply purposes. The costs of supplies by this scheme compare favorably with present costs of raw water supplied by conventional mehtods of water conservation. The plan also uses minimal land and creates minimal environmental disturbance.

*Water reuse, *Water conservation, *Rivers, Effluents, Sewage, Environmental effects, Capital costs, Sewage treatment

River Thames

D034
HOW TO OPTIMIZE AN ACTIVATED SLUDGE PLANT,

Joyce, R. J., Ortman, C., and Zickefoose, C.

Water and Sewage Works, Vol. 121, No. 10, p 96-99, October, 1974. 15 fig.

The Hillsboro Oregon waste treatment plant treats both municipal wastes from its community and industrial wastes from four food plants. Until July, 1973, the treatment plant had trouble meeting effluent standards, due to large and random variations in plant loading. In order to control effluent standards, it was necessary to make fast measurements of organic loading, as well as other key variables. The activated sludge process is reviewed, in terms of its contact and stabilization steps, and the sludge conditioning time. The Hillsboro plant has a nominal hydraulic capacity of 2 MGD and a complete-mixing aeration tank, which is divided into four quadrants. Sludge conditioning time is quite flexible. The measurement and control actions for the plant are illustrated. Parameters considered for optimal ranges are the food/biomass ratio (F/M), the effluent organic pollutant (BOD5), the return sludge flow (RSF) and the waste sludge (WS). Control strategy is applied so that the F/M ratio, the settling volume for 5 minutes, and the respiration rate interact with each other. These bring corrective action in terms of increases or decreases in sludge conditioning time, returned sludge flow, and waste return flow.

*Municipal wastes, *Waste treatment, *Treatment facilities, *Activated sludge, Effluents, Hydraulic capacity, Industrial wastes, Standards

Hillsboro, Oregon

D035
FULL-SCALE TRIALS OF POLYELECTROLYTES FOR CONDITIONING OF SEWAGE SLUDGES FOR FILTER PRESSING,

White, M. J. D., and Baskerville, R. C.

Water Pollution Control, Vol. 73, No. 5, p 486-504, 1974. 6 fig, 4 tab, 21 ref.

Sewage sludge is known to be conditioned in the laboratory using polyelectrolytes. Full-scale operation was successfully tried by the Oadby sewage works, with pressing periods from two to five hours. The reasons for failures and disappointing results in the use of polyelectrolytes is discussed. The difficulties associated with the filter pressing of sludge after polyelectrolyte conditioning seems to be due mainly to blinding of the filter medium, to inadequate provision for the discharge of filtrate at a high rate, or to incorrect mixing techniques. Some of the difficulties of blinding the filter medium can be overcome by use of an in-line mixing system; the use of the press feed pump as an in-line mixer may be applied in certain cases. Regular cleaning of the drainage surfaces and the backs of the cloths is necessary to maintain a high rate of filtration flow associated with polymer-conditioned sludges. Thus, if precautions are taken to ensure that satisfactory conditioning is achieved, and that this sludge can then be transported to the press without breaking down the flocs excessively, and if the cloth and drainage surfaces are kept clean and clear, this method can be carried out, offering savings in both costs and time.

*Polyelectrolytes, *Sewage sludge treatment, Filtration, Operation, Treatment facilities, Drainage

*Filter pressing

D036
CONTROL SYSTEM FOR TOTSUKA-DAINT SEWAGE TREATMENT PLANT,

Hattori, Y., Matsumoto, H., Matsuzaki, Y., Endo, M., Negoro, Y., and Ikeda, K.

Toshiba Review, Vol. 29, No. 11, p 937-941, November, 1974. 3 fig, 20 ref.

Management and control of sewage treatment plants are becoming necessary with an increased amount of construction to cope with pollution of rivers adjacent to large cities. The control system of the Totsuka-Daini Sewage Treatment Plant in Japan is described. It features the collective automatic management of multiple sewage treatment plants in block, the automatic operation of waste and storm sewage pumps by means of the computer CLEARAC, the separation of pumping rooms, and a tele-control system which connects these pumping rooms to a central control for supervisory control. In addition, contacts in the sequence circuit are eliminated, and sequence change is accomplished by the use of the computer PROSEC. Automatic and interlocked operation of individual treatment plants is practiced in addition to the centralized supervisory control of the overall plant.

*Sewage treatment, *Treatment facilities, Urban areas, Management, Computers, Control system, Pumps

Japan, Treatment plants

D037
DISPOSING OF LIQUID WASTES UNDERGROUND,

Environmental Science and Technology, Vol. 9, No. 1, p 24, 1975. 1 fig.

Disposal of wastes by injection into deep wells has been practiced for over fifty years. Within the last decade, however, surface waters have become less capable of receiving effluents within water quality standards, and injection into wells has become an attractive alternative disposal method. For adequate protection of potable water, aquifers used for liquid waste disposal should have the following characteristics: a zone with sufficient permeability, porosity, thickness and area to act as a storage reservoir; and a zone that is vertically below fresh water circulation and confined by rock stratum impermeable to waste liquids. The aquifer should be structured so that waste liquids are injected to a zone at least 1000 feet below the land surface, and one or more strata should be impermeable to the vertical movement of wastes. A test project for a new injection well for sewage-treated effluent is being completed in West Palm Beach, Florida, for 1976. It is a 3500-foot deep well, being constructed for test injection and for subsequent use in monitoring. It is possible that treated water, pumped underground, may be a viable water supply at some future time.

*Liquid wastes, *Waste disposal wells, *Injection wells, Aquifers, Potable, Florida, Permeability

D038
EXPANDING CLEVELAND'S SOUTHERLY WASTEWATER TREATMENT PLANT,

Water and Sewage Works, Vol. 121, No. 11, p 86-88, November, 1974. 3 fig, 5 tab.

The city of Cleveland, Ohio has three waste water treatment plants; of these, the Southerly plant has not met water quality standards. The City of Cleveland, the United States Environmental Protection Agency, and the state of Ohio are now working on the design of systems to solve three problems: to eliminate discharges of untreated industrial wastes; to minimize combined sewer discharge effects; and to upgrade the level of treatment at the Southerly Wastewater Treatment Center. The basis of a new design was that all flow to the plant up to 400 mgd be given complete treatment and that all flows in excess of 400 mgd up to 735 mgd be given the equivalent of primary treatment and disinfection with provisions available for the addition of organic and/or inorganic flocculants. A treatment system has been selected consisting of primary sedimentation, two-stage activated sludge system, and effluent polishing by filtration and disinfection. A wet-stream process system requires the construction of additional headworks, screening and grit removal facilities, additional primary treatment facilities, modification of an existing aeration system, construction of additional first-stage clarifiers, construction of effluent filtration and disinfection systems. Sludge handling consists of degritting and thickening of the sludges; storage; dewatering; and incineration. An on-site disposal system is presently used, but future land disposal is also feasible.

*Waste treatment, *Treatment facilities, Design criteria, Sewage treatment, Municipal wastes, Sludge, Biological treatment, Waste disposal

Cleveland, Ohio

D039
WHEN TO USE CONTINUOUS FILTRATION HARDWARE,

Emmett, R. C., and Silverblatt, C. E.

Envirotech Corporation
Salt Lake City, Utah

Chemical Engineering Progress, Vol. 70, No. 12, p 38-42, December, 1974. 3 fig, 1 tab, 7 ref.

Selection of the proper filtration equipment for a particular application requires guidelines. Detailed are the types of slurries that can be handled by continuous filtration, the factors that must be considered in a flowsheets, and the costs and benefits involved. Feed slurry properties include: suspended solids concentration, particle size distribution, system composition, liquid viscosity, liquid volatility, degree of liquid saturation, temperature, special properties of solids or liquid, required materials of construction, and feed rate. Filtration requirements analysis should consider several facets of operation. One can never obtain a high filtration rate, an absolutely clear filtrate, a completely washed cake, and an extremely low residual cake liquor content. Requirements should include minimum performance which can be reasonably tolerated and take capital and operating costs into account. These requirements include: filtrate clarity, cake washing, cake moisture, filtrate dilution, end use of solids, capital limitation, total process flowsheet, product value and in-process inventory, chemical conditioning, and pretreatment of slurry. Bench scale testing begins with choice of a filter medium and should be designed to determine the rate of its operations as applied to possible type of continuous filtration equipment. In considering the available solid-liquid separation methods, economics should be the final decision, with flexibility and dependibility for a practical system.

*Filtration, *Equipment, Waste treatment, Slurries, Sludge, Capital costs, Operating costs, Construction

D040
POLLUTION LAB PAYS OFF--TWO WAYS,

World Ports, Vol. 37, No. 4, p 20-21, March, 1975.

The operation of an oily ballast disposal plant at the Swan Island Ship Repair Yard, Portland, is monitored so that waste water may be properly treated and then discharged to the municipal sewer system. Incoming material is checked for emulsification, to be sure that water is not chemically emulsified; for pH level, which must be corrected to be within the range 5.5 to 9.0; and for salt water content, which must be below 10,000 ppm. These criteria ensure that the ballast wastes will not kill the bacteria used in the sewage treatment system. Incoming waste water originates mainly from ships in drydock, where oil may have seeped into the bilge or where salt water may have been taken on as ballast while at sea. This water is treated in a separator where oil is skimmed off and remaining water is then tested. Water of an acceptable quality is dumped into the sewer system. The oil is sold for use in road work and rerefinement. Protection against oil spills is provided by two oil skimmers at the shipyard.

*Oil pollution, *Industrial wastes, *Combined wastes, *Oil spills, Monitoring, Water pollution control

Ballast wastes, Oil skimmers

D041
THE CONSEQUENCES OF ACCEPTING INDUSTRIAL WASTES INTO SEWERS. WATER POLLUTION RESEARCH AT STEVENAGE,

Borne, J.

Water Research Centre, Stevenage Laboratory,
Stevenage, Herts, Great Britain

Chemistry and Industry, No. 1, p 1, 13-17, January 4, 1975. 2 fig, 1 tab, 5 ref.

Legislation governing the discharge of effluents from various industries into municipal sewers was discussed at a symposium organized by the Water and Environmental Group of the SCI. One aspect of this work was a series of laboratory investigations conducted by the Water Research Centre at Stevenage. In compliance with legislation, a form of Consent is necessary for any industry to discharge into sewer waters. The Consent specifically restricts materials such as petroleum spirit and organic solvents, as well as controlling temperature, flow rate, and pH. Difficulties and high costs associated with accepting such trade effluents are related to three aspects of sewage treatment--anaerobic sludge digestion and dewatering of sewage sludge, biological oxidation, and disposal of the treated effluent. The Laboratory has tested the biodegradability of constituents of industrial waste waters in admixture with sewage, using batch tests in several proportions. They also investigated the possible effects of inhibitory chemicals on the process of nitrification. Techniques are discussed for physico-chemical partial pre-treatment methods, so as to reduce the strength of industrial wastes before their discharge to a local authority sewer. Evaluations have also been made of disposal of the treated effluent in the framework of water reuse and stricter water quality requirements for sewage effluents.

*Legislation, *Waste disposal, *Industrial wastes, Sewers, Laboratory tests, Pre-treatment, Water quality requirements, Sewage, Organic matter

Great Britain, Physico-chemical treatment

D042
ASBESTOS IN POTABLE WATER SUPPLIES,

Olson, H. L.

Johns-Manville Sales Corporation, Denver, Colorado,
Public Water Pipe Division

Journal of the American Water Works Association, Vol. 66, No. 9, p 515-518, September, 1974. 8 fig.

There are currently an estimated 1.5 million miles of asbestos-cement pipes used for water distribution; more than 200,000 miles are in the United States. The question has arisen as to whether the asbestos fibers in water supplies might be related to the risk of gastrointestinal (GI) cancer. A research project was conducted which reviewed available literature and statistics, developed techniques to measure the amount of asbestos fibers in water, used a new technique that employed an electron microscope, and studied two cities to check the asbestos in water samples over an extended period of time. The following conclusions were reached: the incidence of GI cancer has decreased during the same period of time in which asbestos-cement sales have increased; the water flowing through asbestos-cement pipe picks up very little asbestos; many source waters contain more asbestos fiber than does water that flows from asbestos-cement pipes; if the maximum asbestos-fiber content in water was observed, the total amount of asbestos that would be ingested by a person during a 70 year life span would be 0.77 gram; and, the consumer benefits from the purchase of asbestos-cement water pipe.

*Asbestos cement, *Pipes, *Water quality, *Public health, Pipelines, Construction materials, Asbestos, Distributions systems, Water distribution (applied)

*Castrointestinal cancer

D043
FILTER-PRESSING WASTEWATER SLUDGE,

Water and Sewage Works, Vol. 121, No. 9, p 108-111, September, 1974. 1 fig, 1 tab.

The Kenosha, Wisconsin, waste water treatment plant is the first one in the United States to dewater sewage sludge by filter pressing with the Edwards and Jones filter press. The Edwards and Jones filter press process was chosen because of the limited number of personnel required and the use of ferric chloride and lime instead of fly ash as conditioning chemicals. The sludge is continuously fed into the press at a maximum of 100 psi; as the sludge goes into the press, the solids are retained on the cloths and the filtrate comes out and goes into the head end of the plant to be recycled with the raw sewage. The complete cycle takes 3-4 hours. The moisture content of the sludge cakes is about 60%; the dry cake is disposed of as landfill. Amounts of ferric chloride and lime used in the chemical conditioning are 50,000 ppm of ferric chloride on a dry weight basis and 120,000-150,000 ppm lime. The press has a capture rate of at least 99% of the incoming solids. Suspended solids for the filtrate are around 130 mg/liter and BOD figures are around 58-79. The cloth used to filter the waste water is a polypropylene monofilament of a low to medium porosity and will last a year and a half or two years.

*Waste water treatment, *Sludge disposal, *Sludge treatment, *Dewatering, *Filtration, Chemicals, Sewage treatment, Suspended solids, Biochemical oxygen demand, Wisconsin, Landfill

*Filter pressing, Edwards and Jones filter press, Kenosha (Wisc)

D044
STUDY OF INDUSTRIAL AND URBAN WASTEWATER TREATMENT IN THE GORLICE REGION OF THE ROPA RIVER CATCHMENT AREA (BADANIA NAD OCZYSZCZANIEM SCIEKOW PRZEMYSLOWYCH I MIEJSKICH Z REJONU GORLIC ODPROWADZANYCH DO RZEKI ROPY),

Samsonovicz, A.

Gaz, Woda i Technika Sanitarna, Vol. 48, No. 8, p 277-278, 1974. 9 refs.

Studies of the sanitary conditions of Ropa River in the Gorlice Region of Poland were conducted. According to the results of the analyses made at various locations of the river in the vicinity of waste water flow into the Ropa, several conclusions were reached. The effectiveness of present equipment for purification of industrial and municipal waste waters is insufficient. At present, the level of waste water purification in the catchment area to preserve purity of the Ropa River at the highest level reaches the following values: 70.5% BTU5; 78.0% oxygenation; 89.5% ether extract; 68.4% overall suspension; and, 99.2% phenol, the latter originating from infiltrations from containers situated 150 m from the Ropa River catchment area. The problem will be solved by building a retention collector on the river in Klimkowka. The river will be purified of phenols, for the present time. Infiltrations from the so-called acid pits to the river will be substantially limited in order to increase collector accumulation potential and the Ropa River's sanitary characteristics.

Waste water, Rivers, Municipal wastes, Industrial wastes, Phenols, Water quality control

Ropa River, Poland

D045
STUDIES CONCERNING DEWATERING OF DIGESTED COMMUNAL WASTE WATER SLUDGES ON SLUDGE DRYING BEDS (UNTERSUCHUNGEN ZUR ENTWAESSERUNG AUSGEFAULTER KOMMUNALER ABWASSERSCHLAEMME AUF SCHLAMMTROCKENPLATZEN),

Boehm, R.

Wasserwirtschaft-Wassertechnik, Vol. 24, No. 8, p 280-284, 1974. 6 fig, 4 tab, 5 ref.

Digested sludges from water purification formerly had to be dried in beds with a depth of 20 cm because they were then manually removed. For the use of automatic sludge removal equipment, higher layers are better suitable. For determination of the effect of the thicker layer on the drying process, experiments were carried out in: 4 by 8 m drying areas with concrete bases and drainage pipes; in 4 by 8 beds with cobbled bases and drainage pipes; and in 4 by 8 m beds with gravel bases. Over a period of several years, the influence of the sludge layer (20, 30, or 40 cm), the type of base (concrete, cobbled pavement, or gravel), and the origin of the sludge (mechanical or mechanical-biological waste water treatment) was studied under natural conditions. Sludges dried on the concrete base had a relatively pasty bottom layer while the top and center did not differ much from those in sludges dried on gravel bases. For automatic cleaning of sludge drying areas, a layer with a depth of 40 cm was found to be best. The drying process was impaired by the concrete base, particularly with sludges from activated sludge treatment stations.

*Sludge treatment, *Dewatering, Automation, Waste water treatment, Activated sludge, Water purification, Sludge disposal

Sludge drying beds

D046
EVOLUTION OF MICROFLORA DURING PURIFICATION TREATMENT OF URBAN WATER BY ACTIVATED SLUDGE (EVOLUTION DE LA MICROFLORE AU COURS D'UN TRAITEMENT D'EPURATION D'EAUX URBAINES PAR BOUES ACTIVEES),

Riviere, J.

Laboratoire de Recherches de la Chaire de Microbiologie
Institut national agronomique Paris-Grignon,
Paris, France

Annales Agronomiques, Vol. 25, No. 2-3, p 515-533, 1974. 9 tab, 46 ref.

Two stations of very different size and design were compared for their efficiency of bacterial pollution, during treatment of urban water by the activated sludge process. It appeared that: bacterial microflora were quite homogeneous in the ventilation tanks; and, compared to the inflow, a reduction of almost 90% the number of bacteria that can be revitalized is found in the outflow, for both Escherichia coli and fecal streptococci. However, neither station checked the sulphite reducing Clostridium spores. Very few nitrifying bacteria were found in either outflow. Ammonifying bacteria were checked by the station but aerobic nitrogen bacteria were not. Odor producing bacteria, which were very numerous in the inflow, were reduced by 80% in the outflow, including indologeneous bacteria and hydrogen sulphide producing bacteria. The outflow contained considerable numbers of sulphate reducing bacteria, often a cause of chemical corrosion. Bacterial pollution checking-capacity of a large station was seen to be slightly less than that of an average size station.

*Bacteria, Biological treatment, Activated sludge, Measurement, Water pollution, Escherichia coli, Nitrogen, Ammonia, Waste water treatment, Odors, Municipal water, Treatment facilities

Bacterial pollution, Microflora

D047
PILOT-PLANT INVESTIGATIONS INTO PARTIAL PRETREATMENT SYSTEMS AT MACCLESFIELD,

Hamibleton, F. E., and Kirby, T. H.

Water Pollution Control, Vol. 73, No. 5, p 521-531, 1974. 4 fig, 3 tab, 6 ref.

Continued growth of the population in the drainage area coupled with the expansion of a pharmaceutical factory led to demand for additional capacity at the treatment works at Macclesfield, Great Britain. A biological treatment plant had been installed between 1961 and 1964. Experimental work on biological filtration was carried out between 1966 and 1969. In 1970, a second program was tested to assess the effectiveness of partial pretreatment of settled sewage for the reduction of BOD before its discharge onto biological filters. Two partial pre-treatment systems were examined: a high-rate activated sludge system using surface aeration; and a high-rate biological filtration using plastics filter media, each with a pilot plant. Comparisons of costs and efficiencies are given. It was concluded that a pilot plant is far more difficult to operate effectively than a full sized sewage works. Additionally, while a high rate activated sludge unit requires only the existing filter beds to be retained for secondary biological filtration, a high rate filtration unit needs the addition of extensive supplementary low rate biological filters.

*Biological treatment, *Pre-treatment, Activated sludge, Filtration, Pilot plants, Sewage treatment, Costs, Construction materials

High rate biological treatment, Macclesfield (Great Britain)

D048
TECHNOLOGICAL AND ECONOMIC EFFECTS OF THE CHANGE OF THE PRELIMINARY PURIFICATION TIME ON SLUDGE TREATMENT (TECHNOLOGISCHE UND OEKONOMISCHE AUSWIRKUNGEN DER VERAENDERUNG DER VORKLAERZEIT AUF DIE SCHLAMMBEHANDLUNG),

Hagen, H.

Wasserwirtschaft-Wassertechnik, Vol. 24, No. 8, p 277-279, 1974. 4 fig, 1 tab, 10 ref.

Sludge quantity within a waste water treatment plant depends upon the origin, the quantity of dry substance, and the water content of the sludge. Sludge originating from mechanical purification is different from excess sludge after purification. The quantity of sludge from preliminary purification decreases with decreasing residence time in the preliminary purification basin. An optimization calculation was carried out to determine the residence time in the preliminary purification basin at which the sum of the costs for preliminary purification and for sludge treatment approach a minimum. An optimum preliminary purification time of one to two hours was obtained, assuming a dry substance content of 5.7% in mixed sludge and 2.5% in excess sludge. Thus, the volume of the preliminary purification basin influences the composition of the sludge to be digested. If the residence time in the preliminary purification basin drops, the quantity of organic matter going to the aerobic stage rises, and with it the quantity of excess sludge to be removed from the activation basin.

*Sludge treatment, *Costs, Waste treatment, Organic matter, Aerobic treatment

Activation basins, Sludge quantity, Residence time

D049
RECENT DEVELOPMENTS IN SEWAGE TREATMENT BASED ON PHYSICO-CHEMICAL METHODS,

Cooper, P. F., and Thomas, E. V.

Water Pollution Research Laboratory of the
Department of the Environment,
Great Britain

Water Pollution Control, Vol. 73, No. 5, p 505-520, 1974. 7 fig, 11 tab, 17 ref.

Physico-chemical treatment for sewage is defined as chemically aided clarification followed by the removal of dissolved organic material usually by adsorption on activated carbon. The use of physico-chemical treatment (PCT) is more common in the United States than in Great Britain, but is still at the pilot plant stage. Advantages claimed for PCT over biological treatment include reductions in capital costs and land requirements; easier control of the plant in terms of adapting to fluctuations in sewage quantity and quality; reduced susceptibility of the chemical stage to toxic materials; and, almost complete removal of phosphorus and nitrogen where eutrophication is a problem. Recent developments in the United States and tests in Great Britain are described. Pilot plants in the UK include one at the Coleshill works of the Upper Tame Main Drainage Authority and the Cramlington works of the Seaton Valley Urban District Council of Northumberland. The PCT process may be applicable for primary clarification to permit discharge to coastal waters through a shorter outfall pipe, in the use of a chemical coagulant in the primary sedimentation stage to relieve an overloaded conventional plant, or by the use of PCT with a biological stage to remove carbonaceous and possibly nitrogenous constituents prior to activated carbon treatment.

*Sewage treatment, Activated carbon, Pilot plants, Waste treatment, Clarification, Treatment facilities, Biological treatment, Costs

*Great Britain, *Physico-chemical treatment

D050
PHYSICAL CHARACTERISTICS OF MECHANICAL AERATORS,

Clough, G. F. G.

Water Pollution Control, Vol. 73, No. 5, p 564-575, 1974. 9 fig, 3 ref.

Mechanical aerators as a central part of the activated sludge system for sewage treatment are discussed. Selection of an appropriate aerator is dependent upon a number of characteristics. New aerator designs thus far have shown no significant improvement over previous ones. The functions of a mechanical aerator are detailed. These include: dissolving oxygen in the water within the aeration tank; maintaining the activated sludge solids in suspension; mixing the water containing dissolved oxygen with the solids so that the bacteria have a continuous supply of dissolved oxygen; distributing waste throughout the tank; and removing some carbon dioxide from the solution. In addition, the aerator cools the aeration tank contents, produces spray and mist, causes foaming, and produces some noise. Selection of a particular aerator should be based on the importance of its various functions, the net oxygen transfer efficiency, and the operational costs involved.

Aeration, Activated sludge, Sewage treatment, Equipment, Operational costs, Dissolved oxygen

Mechanical aerators, Aerators

D051
NITRIFICATION EFFECTS IN WASTE TREATMENT PROCESSES,

Olenik, T. J.

Dissertation Abstracts International B, Vol. 35, No. 6, p 2789, 1974.

Nitrification or second-stage biochemical oxygen demand effects were studied on two waste water treatment plants along the Passaic River in New Jersey. The Berkeley Heights and Madison-Chatham plants were analyzed by inorganic nitrogen and dissolved oxygen tests of both internal and external flows. Nitrification was not found on an overall basis at either facility. Kinetic rate constants for all effluents were measured. In the long term dissolved oxygen tests, ammonia nitrogen disappearance was considered to be caused by heterotrophic bacteria and by nitrifying autotrophic bacteria. In addition, lithium chloride was used as a tracer on the mechanical aeration unit of the Madison-Chatham plant. This examined the amount of dead space in the tank to allow multiplication of nitrifying organisms. The receiving waters of the Passaic River were analyzed for two years for their deterministic and stochastic properties of ammonia-nitrogen values. Results showed random distribution in time with some correlation in space.

*Nitrification, *Ammonia, Nitrogen, Biochemical oxygen demand, Waste water treatment, Treatment facilities, Aeration, Waste treatment, Bacteria

Passaic River (New Jersey)

D052
APPLICATION OF FILTRATION THROUGH SEMI-PERMEABLE MEMBRANES FOR TREATMENT OF WASTES,

Kepinski, J., and Chlubek, N.

National Technical Information Service Report No. AD-781 244, May 3, 1974. 9 p, 2 fig, 5 tab, 22 ref.

The basis of the hyperfiltration (reverse osmosis) process is discussed as well as the characteristics of membranes and hollow fibers and applications of reverse osmosis in the treatment of industrial and municipal wastes. Reverse osmosis was originally developed as a method of desalting salt and brackish waters. In practice, the pressures used in reverse osmosis are several times greater than the difference between the osmotic pressures of the substrate and the product, in order to compensate for the unfavorable phenomenon of concentration polarization and to increase the speed of the process. Heavy metal ions are relatively easily separated from others by the method of hyperfiltration. Reverse osmosis can also be used in the treatment of radioactive wastes where the concern is with reducing the volume before decontamination. An experimental apparatus used for treating the acidic waste water from the Kittanning mine in Pennsylvania was capable of producing over 5 cu m of desalinated water daily. Reverse osmosis is also being used in the treatment of salted mine waters, tanning wastes, detergents, colorings, pesticides, and wastes from cellulose and paper factories. Reverse osmosis is used for treating municipal waste water where the reuse of water is necessary because of a limited supply. The Los Angeles region reuses municipal wastes treated by reverse osmosis for agricultural and industrial purposes. Regeneration of water from wastes in space-vehicles is another specific application of reverse osmosis.

*Reverse osmosis, *Membrane processes, *Waste water treatment, Water reuse, Water purification, Reclaimed water, Desalination, Desalination processes, Municipal wastes, Industrial wastes, Radioactive waste disposal, Acid mine

D053
POLLUTION CONTROL,

Benedek, A., and Redekopp, A. B.

McMaster University, Hamilton, Ontario

Water and Pollution Control, Vol. 112, No. 9, p 24-26, September, 1974.

The range and type of waste water treatment unit operations has changed little over the last sixty years although the volume and nature of municipal and industrial waste waters has changed radically. Activated carbon adsorption is considered the most important organic removal process to be developed since the advent of the activated sludge process in 1912. Activated carbon is a relatively cheap, non-specific adsorbent with a high capacity for most waste water organics. Activated carbon columns are used as tertiary treatment to remove nonbiodegradable components of waste water. Water that is directly or indirectly recirculated needs to have all possible organic matter removed; activated carbon treatment following biological oxidation is an economical and reliable method for this. Plants are now in operation based on the physical-chemical treatment procedure. Raw sewage entering such plants is chemically clarified with one of the metal coagulants used in phosphorous removal such as alum, ferric or ferrous salts or lime, and a polymeric flocculant. Chemical clarification can remove more than 90% of the suspended solids in sewage. The clarified waste water is fed to activated carbon columns, with or without filtration. The advantages of physical-chemical treatment over conventional treatment include: high organic treatment levels; almost complete suspended solids and phosphorus removal; good removal of most non-biodegradable organics and trace metal ions; low required land levels; low initial capital cost; easy start-up; insensitivity to biological toxins; and, capability of handling highly fluctuating feed concentrations.

*Activated carbon, *Waste water treatment, *Municipal wastes, *Industrial wastes, Sewage treatment, Tertiary treatment, Adsorption

D054
SLUDGE DISPOSAL,

Aqua, No. 2, p 40-41, 1974.

Sludge is defined as any suspension of solid material in a liquid. A panel research group developed the following conclusions concerning sludge disposal: the disposal of sludge should be accounted for at the design stage of a new plant; sludge disposal should be operated as an integral part of the treatment process, eliminating temporary lagoons; direct discharge to water courses is to be avoided; lagooning is also not recommended; discharge to sewers is encouraged, provided the economic considerations are reasonable and there are no problems in the transmission stage; after thickening with polyelectrolyte, the most effective method for treating coagulant sludges is by filter pressing; and methods for softening sludges, for example centrifuging or vacuum filtration, are available.

*Sludge disposal, *Water pollution, *Waste water treatment, Lagoons, Sewers, Discharge, Polyelectrolytes, Centrifugation, Suspended solids

*Coagulant sludges, Filter presses, Lime sludge

D055
WATER RESEARCH CENTER UNRAVELS THE NITRATE KNOT,

Naughton, J.

Surveyor, Vol. 4285, p 12-16, July, 1974. 6 fig.

The Water Research Center, United Kingdom, has investigated the hazards of nitrates from sewage effluents and other sources reaching drinking water supplies. An evaluation was made of the different methods of nitrate removal from sewage effluents at the WRC Stevenage Laboratory, consummated by the start of full-scale trials at the Rye Meads Sewage Works on the Lee River. The method developed resulted in savings in treatment costs, and in the capital costs of new works. Sewage and agricultural run-off are the greatest contributors to the nitrate problem. Research at Stevenage concentrated on the flooded filter concept. The method works on the principle that there exists a group of facultative heterotrophic bacteria capable of modifying their metabolism to use nitrate as a source of oxygen when there is no dissolved oxygen. Nitrate removal then can be effected by the deprivation of oxygen to a nitrified effluent, containing these bacteria. An additional source of carbon is needed to achieve an adequate rate of oxygen utilization and denitrification. Molasses and methanol are the cheapest carbonaceous materials for convenient use. Nitrate removals of about 90 percent are achieved with flooded filters, while experiments at low temperatures showed a reduced efficiency in the filters below 10 C.

*Nitrate removal, *Water pollution, *Effluent control, *Sludge disposal, Runoff, Sewage effluent, Industrial wastes, Domestic wastes, Waste water treatment, Activated sludge, Biological filtration, Discharges, Clarification

*Heteortrophic bacteria, Methanol, Molasses

D056
SOUND WAVES AND OZONE STERILIZE WASTEWATER,

The American City, Vol. 89, No. 9, p 137, September, 1974. 2 fig.

An effective method of disinfecting waste water involves the use of UHF sound waves and ozone, eliminating the hazards associated with chlorinated hydrocarbons released during chlorination. The estimated savings are about one cent per 1000 gallons. The treatment includes chemical coagulation, using iron salts and polymer additives to remove much of the phosphates and some nitrates; settling for sludge removal; rapid sand filtration; and sonics with ozone emitted from Welsbach generators. Bacteria is dispersed by the sonic waves. When the aggregate particles are broken up, a greater surface area is exposed to ozone oxidation, and the ozone demand is reduced. The sonics-ozone treatment is most helpful in plants now requiring prechlorination or intermediate chlorination during the treatment process. Waste water is retained only half the time of a conventional plant. The system has been shown to destroy polio virus, cholera, salmonella, shigella, E. coli, staphylococcus and other microorganisms of public health concern associated with waste water.

*Waste water treatment, *Water pollution, *Chlorination, *Sound waves, *Ozone, Coagulation, Polymers, Sludge removal, Filtration, Bacteria, Virus, Public health

*Sonozone treatment, *UHF sound waves, Rapid sand filters, Vertical pressure filters

D057
ZETA POTENTIAL CONTROLS DIRECT FILTRATION COAGULATION,

Letterman, R. D., and Tanner, R. D.

Water and Sewage Works, Vol. 121, No. 8, p 62-65, August, 1974. 9 fig, 2 tab, 12 ref.

Currently growing is the practice of designing water treatment plants treating low turbidity water without the conventional sedimentation basins and flocculators and feeding coagulant treated water directly to the filters. The results are presented from a six month study using pilot filters at the Central Water Filtration Plant in Chicago, Illinois, and water from Lake Michigan to demonstrate how particle zeta-potential measurements can be used to determine the cationic polyelectrolyte concentration needed for effective operation of the direct filtration process. The polymers studied, Cat-Floc T, Nalcolyte 607, Nalcolyte 8101, and Magnifloc 570-C, each demonstrated an effective concentration range and an optimum concentration. The effective range corresponded to particle zeta potentials in the range -6 to 26 mv. The optimum concentration corresponded to a zeta potential of about 14 mv. When the optimum polymer concentration was achieved, maximum turbidity removal, maximum head loss development, and a shortened ripening period resulted. The amount of polymer that was required to reach a given particle zeta potential increased slightly as the influent water turbidity rose from 0.6 to 35.0 FTU. The effluent turbidity was independent of the influent turbidity in the effective concentration range. The rate of head loss buildup depended to a significant degree on the type of polymer utilized but the turbidity was effectively removed by all the polymers studied.

*Water treatment, *Filtration, *Polymers, *Zeta potential, Polyelectrolytes, Turbidity, Water quality control, Water quality, Coagulation, Pilot plants

*Direct filtration

D058
INTERACTIONS OF HEAVY METALS IN THE ACTIVATED SLUDGE PROCESS,

Cheng, M. H.

Illinois Institute of Technology, Chicago, Illinois

Dissertation Abstracts International B, Vol. 35, No. 4, p 1705, 1974.

Although many reports on the toxic effects of heavy metals on biological waste treatment processes have appeared in the literature, little is known about the physical-chemical interactions within the process between the sludge mass and dissolved metal ions. The kinetics of heavy metals uptake by activated sludge, the ability of the sludge to concentrate metal ions from waste water and the affinity of the sludge mass for metal ions were researched. Metal uptake by the sludge was found to be dependent upon such factors as pH, and the concentrations of sludge, soluble supernatant organics, and metal ions present in the system. Binding capacity appeared to increase with increasing pH, and higher initial concentration of either metal ions or MLSS also augmented the uptake efficiency. If the proper conditions are present the sludge can concentrate heavy metals up to 2 percent or more (by weight) of the sludge mass, even at low initial soluble metal levels. Good correlation was found between the metal uptake by activated sludge and the expression of Freundlich or Langmuir Isotherm. At high initial metal concentrations, the metal ions precipitate and are entrapped within the biological floc of the activated sludge system. At lower metal concentrations, the metals are taken up by the biomass through other mechanisms, such as physical adsorption, complexation and diffusion.

*Activated sludge, *Heavy metals, *Waste water treatment, *Toxicity, Biological treatment, Sludge, Waste treatment, Chemical reactions

Freundlich equation, Langmuir Isotherm

D059
OPERATING RESULTS OF ELECTRODIALYSIS AND REVERSE OSMOSIS MUNICIPAL DESALTING PLANTS,

Skrinde, R. T., and Tang, T. L.

Reynolds, Smith and Hills, Architects-Engineers-Planners, Incorporated,
Jacksonville, Florida

National Water Supply Improvement Association Journal, Vol. 1, No. 1, p 15-21, July, 1974. 8 tab.

Electrodialysis and reverse osmosis are the two primary membrane processes utilized in the desalination of salt and brackish water. Their use to provide potable drinking water from brackish waters is now accelerating rapidly. In January, 1972, there were 812 land-based desalting plants of 25,000 gpd capacity or larger throughout the world. Electrodialysis appears to be best suited for treatment of low total dissolved solids well water in order to meet the public health drinking water standards. Electrodialysis treatment with 30 percent salt passage of a well water with 2000 ppm TDS results in a product water of 600 ppm TDS, which is 100 ppm higher than the permissible level. However, reverse osmosis can treat well waters with much higher TDS contents. Treatment of a well water of 7000 TDS by reverse osmosis with 6 percent salt passage reduced the TDS content in the product water to 420 ppm TDS. The greatest application of electrodialysis is for low TDS waters which will not increase substantially over the years; reverse osmosis should be used where the TDS level is higher and a degradation of well water quality over the years is expected. The operating results of three electrodialysis and three reverse osmosis municipal treatment plants are summarized. A comparative analysis is presented of product water quality and operating costs in plants based upon these two membrane processes.

*Desalination, *Reverse osmosis, *Electrodialysis, *Potable water, Public health, Water supply, Membrane processes, Water purification, Facilities, Costs

D060
HOW TO GET LOW AMMONIA EFFLUENTS,

Sampayo, F. F.

Jones and Henry Engineers, Limited, Lima, Ohio.

Water and Sewage Works, Vol. 121, No. 8, p 92-94, August, 1974. 3 tab.

The use of a plastic media trickling filter (Surfpac) for removing ammonia from effluents was studied at the Lima, Ohio, waste water treatment plant. The pilot plant was a steel shell 3 ft in diameter and 30 ft high packed with 21.5 ft of Surfpac media. Analysis of the summertime results showed that: plastic media trickling filters can produce effluents with less than 0.5 mg/liter ammonia nitrogen levels; recirculation of the filter effluent was beneficial in producing a more stable ammonia nitrogen concentration when the flow rate was high; the major effect of the tower was nitrification rather than stripping of the ammonia; and no net BOD removal or change in suspended solids concentration or pH value was effected by the tower. Analysis of the wintertime data showed that: ammonia oxidation was reduced in the winter; ammonia nitrogen levels less than 1.0 mg/liter were unobtainable; no BOD removal occurred through the tower; some of the suspended solids were removed by the tower; and the pH of the waste increased 0.1 units through the tower. Plastic media in nitrification towers are a viable means for removing ammonia nitrogen. However, to maintain very low ammonia nitrogen levels all year, breakpoint chlorination may be necessary for final polishing. The process is reliable and does not require skilled operators.

*Trickling filters, *Ammonia, *Nitrification, *Sewage treatment, Filtration, Biochemical oxygen demand, Suspended solids, Plastics

Surfpac, Plastic media, Lima (Ohio)

D061
ACTIVATED CARBON USED TO CONTROL ODORS,

Lovett, W. D., and Poltorak, R. L.

Calgon Corporation, Pittsburgh, Pennsylvania

Water and Sewage Works, Vol. 121, No. 8, p 74-75, August, 1974. 1 fig.

Activated carbon adsorption systems are discussed as means for controlling odors from typical low concentration/large volume emissions, storage tanks, reactor vessels, and other small volume sources. Activated carbon's ability to adsorb organic and some inorganic materials in preference to water vapor is due to its non-polar surface. Organic substances with molecular weights greater than 45 and boiling points higher than 0 C are readily adsorbed. Activated carbon can be reused after being regenerated. Regeneration can be accomplished by passing hot gas or steam through the carbon bed, by heating the carbon in a furnace, by a pressure swing such as the use of a vacuum, or by a combination of heat and vacuum, solvent washing or chemical treatment. The ability of activated carbon to increase the concentration of a combustible material can be utilized to decrease the fuel requirement for an incinerator. Many complaints about odors have been received by sewage treatment plants throughout the United States. One installation in California is controlling odors from trickling filters with hypochlorite scrubbing and subsequent adsorption. Odors from primary clarifiers can also be adsorbed by activated carbon. Carbon systems may be made more efficient by decreasing cycle times and/or adsorption temperatures. The characteristics of activated carbon are what make it useful for use in sewage odor abatement.

*Activated carbon, *Odor, *Adsorption, *Sewage treatment, Pollution abatement, Tertiary treatment

D062
LARGEST ADVANCED WASTEWATER TREATMENT PLANT IN THE U. S. AND IN THE WORLD,

Schwinn, D. E., and Tozer, G. K.

Stearns and Wheler, Cazenovia, New York

Environmental Science and Technology, Vol. 8, No. 10, p 892-897, October, 1974. 5 fig, 1 tab.

The District of Columbia's Blue Plains Water Pollution Control Facility has been studied since 1968, and key process steps to improve the plant have been underway since 1971. Design steps have been implemented concurrently with confirmatory tests at the EPA-DC Pilot Plant on D. C. waste water. Methods which were analyzed included: nitrogen removal by the biological nitrification-denitrification process, consisting of nitrification and denitrification reactors and sedimentation basins; phosphorus removal by the addition of alum and/or ferric chloride to both the secondary modified aeration system and the denitrification system; sludge processing by gravity thickening of primary and storm water sludges; and flotation thickening of secondary and advanced treatment sludges, followed by vacuum filtration and incineration. The advanced waste water treatment facilities were designed for operation in two halves to permit comparative tests while operating at different MLSS concentrations, chemical dosages, and other variables. When the treatment plant is completed, it will contain four computer systems, three for process control and one for data processing. The processes to be controlled by these systems are return sludge, waste sludge, chemical treatment (lime, ferric chloride or alum, methanol, and polymer), and pumping. Using the D. C. concurrent design and pilot plant testing has saved two years of time, and the plant to be built will be the largest of its type.

*Treatment facilities, *Waste water treatment, *District of Columbia, Design criteria, Control, Computers, Tertiary treatment, Planning, Pilot plants

D063
THINK THERMAL,

Sebastian, F. P., Allen, T. D., and Laughlin, W. C.

Envirotech Corporation, Menlo Park, California

Water and Wastes Engineering, Vol. 11, No. 9, p 47-48, 50, September, 1974. 2 fig, 2 tab.

Thermal oxidation of sewage sludge is achieving high levels of technology and performance. A task force of the Environmental Protection Agency published a report in 1972 which stated that modern incineration processes were an acceptable alternative for sludge disposal. Sludge incinerator systems designed to meet existing air quality standards produce acceptable stack emissions of nitrogen oxides, sulfur oxides, odors, and particulate matter. The total destruction of PCB, a type of industrial chemical found sewage sludges which is not biodegradable, is possible when oxidized in combination with sewage sludge. A schematic furnace representation is presented of an advanced design type unit being constructed for the Livermore Water Reclamation Plant, Livermore, California. The top third of the furnace is the drying zone; fresh sludge in this section is dried by the gases from the combustion zone. The middle section of the furnace is where combustion of the dried solids occurs. The remaining ash cools in the lower third of the furnace. Livermore also has plans for a separate multiple hearth furnace to recalcine or reclaim lime used in the treatment process. Sludge incineration by the new methods will contribute less pollutants to the air than the "clean" car of 1976. Sludge incineration is also an environmentally sound method for disposing of industrial liquid wastes.

*Sludge disposal, *Incineration, *Pollution abatement, *Sewage treatment, Ultimate disposal, Solid wastes, Oxidation, Drying, Burning, Equipment, California

Furnaces

D064
SEWAGE WEDS FIVE MUNICIPALITIES,

Michel, H. L., and Artale, J. V.

Parsons, Brinckerhoff, Quade and Douglas, Incorporated,
New York

Water and Wastes Engineering, Vol. 11, No. 9, p 28-31, September, 1974. 3 fig.

The five municipalities of Hamilton Township, West Windsor Township, Washington Township, Borough of Allentown, and part of the Township of Upper Freehold, all in the central part of New Jersey, have joined together in a sewage disposal master plan. The plan is technically, economically, financially, and administratively attractive and is designed to provide service for anticipated needs fifty years from today. The plan is for the two stage expansion of the existing water treatment plant in Hamilton Township. The first stage of expansion would include a new high-rate trickling filter section for secondary biological treatment, additional digested sludge lagoons, improvements to the post-chlorination facilities and the recirculation pumping system in one section of secondary treatment, construction of 12 miles of interceptor sewers, 3 pumping stations and 4 miles of force mains, and a pumping station and force main to transport the treated effluent directly to the Delaware River, about one mile from the main treatment plant. The expansion will increase the capacity of the plant to 11 mgd. The second stage of improving the waste water treatment includes a further expansion of the treatment plant capacity to 30 mgd, an increase in pumping capacity and the construction of five more major interceptors. The system is expected to be completed by 1990 and will be adequate for the service needs of all five municipalities through to the year 2020.

*Waste water treatment, *Sewage disposal, *Facilities, *Sewage treatment, Municipal wastes, Pumping plants, Sewerage, Trickling filters, Biological treatment, Sewage lagoons, Chlorination, New Jersey

220

D065
CHARACTERIZATION OF MIXING IN AERATED LAGOONS,

Murphy, K. L., and Wilson, A. W.

McMaster University, Hamilton, Ontario, Canada,
Department of Chemical Engineering

Journal of the Environmental Division, Vol. 100, No. EE5, p 1105-1117, October, 1974. 7 fig, 2 tab, 18 ref.

Aerated lagoons have evolved from waste stabilization pond design as economical methods for secondary treatment of large volumes of waste. A rational approach for use in characterizing the mixing behavior of aerated lagoons is presented. It is generally assumed that an aerated lagoon behaves like a completely mixed reactor. The two idealized mixing extremes are the Plug Flow Tubular Reactor (PFTR), a hypothetical vessel where the fluid enters at one end and moves down the vessel in uniform piston-like flow to the exit and the Continuous Stirred Tank Reactor (CSTR) where mixing is so intense that no concentration gradients exist and the concentration of the exit stream is equal to the concentration at any point in the vessel. Variations of these models and others were fitted to tracer data taken from prototype aerated lagoons. The following conclusions were drawn from an analysis of the experimental data: mixing patterns in aerated lagoons may differ significantly from the assumptions of either ideal complete mixing or ideal plug flow; macromixing levels in aerated lagoons are more dependent upon lagoon geometry than upon aerator horsepower input over the range studied; dimensionless dispersion number which characterizes the degree of macromixing depends only on the lagoon geometry and flow rate as expressed in this equation for aerated lagoons; and the overall performance of aerated lagoons may be evaluated using the relatively simple unequally-sized CSTR-in-series mode.

*Aerated lagoons, *Waste water treatment, *Mixing, Mathematical models, Aeration, Oxygenation, Sewage treatment, Oxidation lagoons

*Continuous Stirred Tank Reactor, *Plug Flow Tubular Reactor

D066
CARBON CONTACT-FILTRATION: HOW IT WORKS,

Lee, C. R., and Takamatsu, T.

Seelye Stevenson Value and Knecht Consulting Engineers,
New York, New York

Water and Sewage Works, Vol. 121, No. 8, p 84-87, August, 1974. 9 fig, 1 tab, 20 ref.

Activated carbon treatment is used to remove dissolved organics or inorganics. The mechanism of removal can be adsorption which actually removes the dissolved organics from the solution and/or bio-oxidation of the adsorbed organics. The mechanism of adsorption is discussed. Physical adsorption results from intermolecular forces of attraction. Chemical adsorption results from the formation of chemical bonds between the molecules of the adsorbate and adsorbent. The adsorption equilibrium depends on the concentration of the materials, gas pressure, and temperature. Equations developed by Freundlich and Longmuir are presented. The theory of contact-filtration is also discussed. Three modes are considered--single-stage system, multi-stage current flow system, and multi-stage counter-current flow system. Waste treatment cost is classified into two groups: capital cost including construction, land, engineering and contingency; and, operation and maintenance cost including fuel, power, maintenance materials and labor. When considering carbon treatment costs, carbon inventory is included in the capital cost and the make-up carbon and carbon regeneration costs are included in the operation and maintenance cost. A cost analysis is presented for the actual expenses incurred at a South Tahoe, Nevada, water reclamation plant during 1969 and 1970 for carbon treatment. Equations, figures, and graphs are used to illustrate expenses and comparisons of costs.

*Activated carbon, *Waste water treatment, *Adsorption, *Tertiary treatment, Costs, Mathematical models, Chemical reactions, Separation techniques

D067
ADVANCES IN AMMONIA AND NITRATE REMOVAL,

Savage, E. S.

Dravo Corporation

Industrial Water Engineering, Vol. 11, No. 4, p 12-16, July/August, 1974. 8 fig.

Nitrogen present in industrial and municipal effluents can cause problems of toxicity, oxygen sag, eutrophication, chlorine demand, and corrosivity. Biological reduction of nitrates commonly occurs in waste treatment plants as a result of the action of facultative microorganisms which utilize oxygen from nitrates when the dissolved oxygen levels are too low. This naturally occurring process can be controlled and optimized for biological denitrification systems. Columnar denitrification, one type of system, is characterized by the fixed positioning of denitrifying bacteria in a packed column. Denitrification and suspended solids removal can be accomplished simultaneously in the same equipment. However, fouling of the denitrification filters and breakthrough of nitrate into the effluent at peak hydraulic rates or during low temperatures can also occur. The Dravo Denite System is described; the main components are the filter bottom, media, and control system. Its filter hardware can accommodate high loadings of suspended solids without excessive head loss and can backwash the high loadings from the filter without gradual fouling of the media and control system. The M-block filter bottom has inherent advantages in design, installation, and operation. Selection of the proper denitrification media depends on size, uniformity, density, and hardness. Automatic operation of the control system is recommended for the nitrogen purge cycle and for filter backwashing. The other controls should be as simple as possible without losing reliability and performance.

*Nitrogen, *Ammonia, *Industrial wastes, *Municipal wastes, *Waste water treatment, Toxicity, Eutrophication, Chlorine, Corrosion, Biological treatment, Denitrification, Microorganisms

Dravo Denite System

D068
ATTITUDES IN SLUDGE TREATMENT AND DISPOSAL,

Dick, R. I.

Delaware University, Newark, Delaware, Department of Civil Engineering

Journal of the Environmental Engineering Division, Vol. 100, No. EE5, p 1077-1087, October, 1974. 1 fig, 31 ref.

A critical analysis of the current practices of sludge management is presented. Sludge treatment and disposal involves thickening, conditioning, dewatering, conversion, transportation, and ultimate disposal. Conclusions stated by the author include: materials incompatible with attempts to reclaim sludge materials or disposal of sludge should not be allowed in sewers; sludge treatment and disposal must both be a part of the design of overall waste management facilities; the effects of both waste water treatment practices on sludge disposal and of sludge treatment practices on waste water treatment processes need to be evaluated more carefully than they have been in the past; not all waste water treatment plants need sludge treatment and disposal facilities; large-scale regional collection and disposal systems which would eliminate sludge handling at most plants are economically feasible and ecologically sound; removal of water from sludges is neither necessary nor economically justified; and, many present sludge management techniques do not include provision for ultimate disposal of the sludge but rather provide for the accumulation of sludges. Improvements are needed in the technology involved in present sludge treatment handling and disposal schemes as well as a reevaluation of some of the basic approaches to the problem.

*Sludge treatment, *Sludge disposal, *Waste water treatment, *Reviews, Sewerage, Sewage, Management, Dewatering

D069
SEDIMENTATION,

Miller, R.

Glaus, Pyle, Schomer, Burns and DeHaven, Akron, Ohio

Water and Wastes Engineering, Vol. 11, No. 9, p 40-42, September, 1974. 2 fig.

It has been necessary in every type of water pollution control treatment to use some form of settling or filter system to remove solids from liquid wastes. A new concept for rapid settling of solids, employing basic gravity settling theories, is the Lamella Separator developed by the Axel Johnson Institute in Sweden. The Lamella is a gravity liquid solid separation unit which utilizes thin parallel plates packed as closely together as possible but still retaining a separation of settled solids from the clear liquid that is to be discharged as effluent. Depending on the application and local conditions, the plates are spaced from 35 to 50 mm apart on an incline of 25 to 50 degrees. The influent is distributed evenly over the plates as it enters in a vertical direction; it then moves downward with the solids which settle to the bottom of each plate. A return tube carries the effluent concurrently with the influent flow and back to the top of the unit where it is discharged. The settling solids drop into the sludge collector at the bottom of the unit. In theory, settling occurs on each plate and each plate provides a settling area equivalent to the projected horizontal area. External forces prevent the theoretical space saving of 20 times from resulting. The actual space saving is about 10 times. A pilot testing program using the Lamella settler parallel with primary settling to provide a comparison was conducted in Youngstown, Ohio. The unit performed well at a flow rate of 200 gpm; a conventional tank would require 10 times the total surface area to handle the same flow. At Youngstown, the system was compact, exhibited a high rate and was not seriously affected by load fluctuations.

*Waste water treatment, *Suspended solids, *Separation techniques, Settling basins, Equipment, Desilting, Settling velocity, Sewage treatment, Water pollution control

*Lamella Separator

D070
ALTERNATIVE METHODS OF DISINFECTION: HOW EFFECTIVE?,

Roberts, K. J., and Vajdic, A. H.

Water and Sewage Works, Vol. 121, No. 9, p 72-75, September, 1974. 1 tab, 18 ref.

Several methods as alternatives to chlorination for waste water or process water disinfection are evaluated, including dechlorination, chemical oxidation, and the use of ultraviolet and gamma ray ionizing radiation. A comparison of percent of inactivation of coliforms, fecal coliforms, fecal streptococci, total bacterial count, bacteriophage, and salmonellae was made for gamma irradiation and chlorine. Effluent from an irradiation reactor was demonstrated to be non-toxic to goldfish for periods of up to six weeks. For certain treatment methods, further toxicity studies are suggested. Of the chemical methods, ozonation shows the most promise, especially with an added benefit of high residual dissolved oxygen in the effluent to the receiving water. With further research, deleterious effects of residual chlorine on aquatic life may be avoided by use of alternate treatment methods.

*Chlorination, *Disinfection, *Ozonation, *Gamma rays, Waste water treatment, Environmental effects, Aquatic life, Bacteria

Dechlorination, Residual chlorine

D071
WATER CHLORINATION METHODS,

Moyer, K. A.

Capital Controls Company

Water and Sewage Works, Vol. 121, No. 9, p 64-65, September 1974. 2 fig.

Chlorination of waste water to destroy pathogenic, disease-producing organisms and avoid other forms of water degradation is used in almost all municipal and industrial water treatment applications. Chlorine gas is considered the best source for almost any chlorination where large volumes of water are to be chlorinated to high levels because it is a pure substance, it lowers pH slightly, is easy to control and apply, and is the cheapest source of chlorine based on pounds of available chlorine. Choosing the proper chlorination system depends on the chlorine demand, the amount of chlorine required to react with the organic and inorganic substances and to kill the bacteria; the chlorine dosage, the amount of chlorine put into the water; the chlorine residual, the amount of chlorine remaining after a specified contact period; and, the flow rate of the water. A water treatment plant that processes water with a constant chlorine demand but that experiences rapid, wide-ranging daily flow variations could use a flow proportioning chlorinator to automatically meter exact amounts of chlorine into the water. When the chlorine demand of the water source varies, it is necessary to use an amperometric instrument to automatically and continuously measure levels of chlorine residual. The best automatic chlorine feeding systems available is compound loop control. This is needed when both the water flow rate and chlorine demand vary significantly in the body of water being treated. It is a combination of a flow proportioning chlorinator and a chlorine residual control system.

*Chlorination, *Water treatment, *Waste water treatment, *Chlorine, Equipment, Water quality control, Water purification, Disinfection, Sewage treatment

Compound Loop Control

D072

VOLUME EXTRACTION OF CHEMICALLY CONTAMINATED WATER,

Shelley, L. W., Jr.

Westinghouse Electric Corporation, Abingdon, Virginia,
Wire Division

Wire Journal, Vol. 8, No. 3, p 67-75, March, 1975. 8 fig, 1 tab.

An industrial accident, in which a valve was opened allowing 500 gal of an emulsified cresylic acid and ortho-dichlorobenzene solution to enter a plant's sewage system and contaminate a 300,000 gal holding tank, created a massive treatment/disposal problem for Westinghouse Electric Corporation. The original plans called for storage and subsequent decontamination of this water by transporting it to a 500,000 gal plastic-lined dry pond, approximately 480 ft above the water table. However, this plan was not acceptable to the Public Health Department. Laboratory tests showed that decontamination could be accomplished by extraction with methylene chloride. 17,000 gal of methylene chloride were pumped into the contaminated tank. The water was agitated by two large compressors pumping air into the 300,000 gal of water. Mixing continued for a period of about six hours. The air compressors were turned off and the water layer and methylene chloride layer were allowed to separate for two hours. The methylene chloride was siphoned from the bottom of the holding tank by running a rubber hose to the bottom and pumping it into tank trucks which then carried the contaminated methylene chloride away to be reclaimed. After the removal of all possible methylene chloride, the air compressors were turned on again to agitate the extract and aerate the solution to remove by evaporation trace amounts of methylene chloride still in solution.

*Waste water treatment, *Separation techniques, *Chemical wastes, Industrial wastes

*Extraction

D073

REDUCTION IN SURFACTANTS BY IRRADIATION,

Rohrer, D. M., and Woodbridge, D. D.

Florida Institute of Technology, Melbourne, Florida,
University Center for Pollution Research

Bulletin of Environmental Contamination and Toxicology, Vol. 13, No. 1, p 31-36, January, 1975. 2 fig, 14 ref.

Although detergents have been determined to be some of the largest contributors to water pollution, the pollution is not produced by the total chemical constituents of the detergents but rather by certain specific chemical structures. Linear Alkylate Sulfonate (LAS) is used as a wetting agent in certain detergents because it creates an effective surface barrier at the water/air interface. This study was designed to investigate the effect of ionizing radiation on Linear Alkylate Sulfonate to overcome the surface tension effect of detergents. More than 200 aqueous samples containing LAS at concentrations of 2.5, 5.0, 7.5, and 10.0 mg/liter were irradiated such that they absorbed 10, 20, 40, 60, 80, and 100 K rads of energy. The results showed that radiation can effectively reduce the concentration of LAS in aqueous solutions. It was also demonstrated that the rate of irradiation is not nearly as important in the reduction of LAS as is the total absorbed energy.

*Waste water treatment, *Detergents, *Surfactants, *Irradiation, Domestic wastes, Municipal wastes, Surface tension

*Linear Alkylate Sulfonate

D074

REMOVAL OF WASTEWATER ORGANICS BY REVERSE OSMOSIS,

Duvel, W. A., Jr., and Helfgott, T.

Michael Baker, Jr., Incorporated, Consulting Engineers,
Beaver, Pennsylvania

Journal of the Water Pollution Control Federation, Vol. 47, No. 1, p 57-65, January, 1975. 5 fig, 1 tab, 19 ref.

Although the advantages and limitations of reverse osmosis as both a separation and a concentration technique have been established, the efficiency of removal of specific organics such as those that might be found in municipal and industrial waste waters is not well known. This investigation was undertaken to answer the following questions: What are the characteristics of a solute molecule that cause it to be rejected or allow it to pass through membranes in the reverse osmosis process?; Why are some solutes rejected and others not?; and, By what mechanisms do molecules actually pass through the membrane?. Solute rejection was found to be semiquantitatively related to both molecular weight and molecular size with molecular size, as determined by steric geometry, as the more important factor. The chemical characteristics of a molecule, particularly its ability to form hydrogen bonds, are qualitatively important in determining permeability. A descriptive mechanism of membrane permeation is given that explains the transport of organic materials through reverse osmosis membranes. This theory makes it possible to predict the success or failure of reverse osmosis in treating waters contaminated by soluble and colloidal organic matter, as long as the chemical nature of the individual contaminants is known. In addition, a constitutent which is permeable might be chemically modified to a nonpermeable form. For example, phenol which is a highly permeable solute could be oxidized with ozone or chlorine dioxide to alter it chemically to a less permeable solute.

*Waste water treatment, *Reverse osmosis, Organic wastes, Phenols, Municipal wastes, Industrial wastes, Permeability

D075
OVERVIEW OF SLUDGE HANDLING AND DISPOSAL,

Farrell, J. B.

National Environmental Research Center,
Cincinnati, Ohio,
U. S. Environmental Protection Agency

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 5-10. 3 fig, 3 tab, 10 ref.

A review is given of both the treatment and the disposal operations now used for municipal waste water treatment of sludge. Trends from 1972 to 1985 are outlined; it is predicted that the amount of secondary treatment sludge will be almost doubled, and chemical sludges will be produced in quantity. It is also predicted that dewatering costs will increase because of the biological secondary sludges and some types of chemical sludges are difficult to dewater, as more municipalities upgrade their facilities to improve effluent quality. Treatment operations have been classified as thickening, stabilization, dewatering, and conditioning. Disposal operations include knowledge of hazards or toxicity, and use of land application, landfill, or incineration. Trends in disposal are difficult to forecast. Ocean disposal appears negative. Land application must be subject to many guidelines; landfill sites are diminishing; incineration faces the problem of the high cost of fuel and air pollution control equipment. New methods of disposal being investigated are co-incineration and co-pyrolysis of sludge with solid wastes.

*Sludge treatment, *Sludge disposal, Reviews, Municipal wastes, Secondary treatment, Dewatering, Filtration, Sewage sludge, Toxicity, Landfill

Land application, Co-pyrolysis, Co-incineration

D076
ALTERNATIVE METHODS FOR SLUDGE MANAGEMENT,

Bernard, H.

Environmental Quality Systems, Incorporated,
Rockville, Maryland

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 11-20. 4 fig, 4 tab, 6 ref.

The holistic environmental viewpoint is considered in alternatives for sludge handling and disposal from waste water treatment plants. Computer methods can be used to consider economic alternatives, such as costs of power, chemicals, or transportation, coupled with emissions standards and availability of land. The sludge processing system involves both treatment of a liquid phase and treatment of a solid phase. While separated solids from sewage treatment is about 0.5 percent of the total liquid phase volume, sludge disposal has the disproportionate cost of about 30 to 50 percent of the total costs associated with waste treatment. Sludge disposal itself is often considered only after final stages of plant design are complete. Suggested for the determination of sludge management alternatives is a consideration of socio-economic-environmental factors. These are enumerated as: energy, air pollution, land use, resource recovery, public attitudes, secondary impacts, surface water quality, nitrogen impact, soil pollution, cropping practices, economic impact, social requirements, and ecological impacts. Disposal alternatives of incineration, land disposal, resource recovery and sale, and composting are described.

*Environmental effects, Sludge disposal, Sludge treatment, Waste water treatment, Costs, Computer models, Sewage treatment, Management

Disposal alternatives

D077
THICKENING OF SLUDGES,

Dick, R. I.

Delaware University,
Newark, Delaware

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 21-28. 5 fig, 13 ref.

While thickening is involved in any system of sludge treatment and disposal, rational approaches to the design and operation of thickeners for an optimal degree of thickening have not been traditionally implemented. This optimal degree of thickening has a significant effect on the total cost of sludge treatment and disposal, because cost effectiveness is dependent upon the concentration of solids in the sludge. Traditionally, thickeners have been sized arbitrarily without regard to the thickening properties of the sludge being treated. However, the size of a thickener does affect the amount of thickening achieved. Size can be computed or estimated if the settling characteristics of the sludge are known. The degree of concentration of sludge depends upon nature of the sludge, size of the community, and types of other sludge treatment and disposal involved in the same system. Rational analyses to determine potential cost reductions are illustrated. These integrate the design of the thickeners with the design of other processes.

*Sludge treatment, Sludge disposal, Mathematical models, Costs, Settling, Waste disposal

*Cost effectiveness, *Thickening, Sludge thickening

D078
ANAEROBIC DIGESTER OPERATION AT THE METROPOLITAN SANITARY DISTRICTS OF GREATER CHICAGO,

Graef, S. P.

The Metropolitan Sanitary District of Greater Chicago,
Chicago, Illinois

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 29-35. 9 tab.

Anaerobic sludge digestion as utilized by the Metropolitan Sanitary District of Greater Chicago is summarized. The capacities of five digestion facilities are compared. Discussed also are digester construction costs, operation and maintenance costs, sludge conditioning and digester flow regimes, heat transfer, loading intensity, gas production, digested sludge characteristics, sludge disposal, and digester problems. Problems, such as thickening, clogging, foaming, gas recirculation, and supernatant separation have been solved. Bench and pilot scale research indicates that future improvements are possible. These include: shorter residence times, resulting from more homogeneous feed sludges, improved flow regimes and more frequent sludge analysis; uniform digester feeding and withdrawal accomplished by automatic mass balance control; on-line measurement of process stability indicators such as the rate of methane production; and, digester gas scrubbing in order to produce a cleaner fuel of higher BTU value, to reduce gas recirculation compressor fouling, and to provide pH control by removing the weak carbonic acid, rather than adding a base. As a means for sludge processing, anaerobic digestion should continue to be a viable method for the treatment of municipal sludges.

*Anaerobic digestion, *Sludge treatment, *Municipal wastes, Construction costs, Digestion, Operating costs, Pilot studies, Sludge disposal

*Chicago (Ill.), *Thickening, Sludge thickening

D079
METRO DENVER'S EXPERIENCE WITH LARGE SCALE AEROBIC DIGESTION OF WASTE ACTIVATED SLUDGE,

Cohen, D. B.

Metropolitan Denver Sewage Disposal District No. 1,
Denver, Colorado

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 37-53. 7 fig, 5 tab, 11 ref.

In 1970, the Metropolitan Denver Sewage District No. 1 (Metro) converted excess secondary aerators to aerobic digestors in two steps. The first part involved plant scale aerobic digestion of dilute W.A.S. in four converted secondary aeration basins. The second part involved extensive research and development to compare pilot open tank oxygen systems using both slot and rotating diffusers with this plant scale system. It was found that V.S.S. reduction was between 11.2% and 47.2% for the air system. A correlation between V.S.S. reduction and S.R.T. x temperature was shown to be significant. When invertebrates (especially rotifers) comprised a significant fraction of the biomass, digestion was maximum. No correlation between dissolved oxygen concentration and V.S.S. digestion rates was observed. At loadings greater than 0.14 pounds V.S.S. per cu ft per day, oxygen performance is superior. Aerobic digestion gives the economic benefit of reduced sludge disposal costs. The Denver Sewage Disposal District (Metro) is now planning to convert a one million gallon tank to an oxygen aerobic digester with rotary diffusers.

*Aerobic treatment, Aeration, Digestion, Pilot plants, Oxygen, Biological treatment, Waste treatment

*Metro, Denver (Colo), Aerobic digestion, Rotary diffusers, Waste activated sludge

D080
HIGH PURITY OXYGEN AEROBIC DIGESTION EXPERIENCES AT SPEEDWAY, INDIANA,

Gay, D. W., Drnevich, R. F., Breider, E. J., and Young, K. W.

Union Carbide Corporation,
Tonawanda, New York,
Linde Division

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 55-66. 6 fig, 7 tab, 8 ref.

Aerobic digestion stabilizes primary waste and/or waste activated sludge through the catabolism of aerobic microorganisms. At the Speedway Indiana Water Pollution Control Plant, a full scale aerobic digestion study was performed, using high purity oxygen. The goal of the investigation was to examine the possibility of attaining and operating at elevated temperatures without an external heat source. The facility's existing UNOX system was modified; the entire waste water flow from its primary clarifier was to be handled by one of two available reactor trains while the other train served as an aerobic digestion unit. During winter operation, the oxygen aerobic digestion was capable of sustaining high (greater than 31 C) temperatures by the conservation of energy produced by endogenous decay. Data obtained from these tests were used to design a full scale aerobic digestion system for Speedway, Indiana. The annual costs for digestion of waste sludge has been evaluated to be $53,400, or the equivalent of $34.00 per ton of dry solids treated.

*Aerobic treatment, *Oxygen, Waste treatment, Microorganisms, Treatment facilities, Clarification, Costs

Speedway Indiana, UNOX, Aerobic digestion, High purity oxygen

D081
SLUDGE DEWATERING,

Carry, C. W., Miele, R. P., and Stahl, J. F.

Los Angeles County Sanitation Districts,
Whittier, California

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 67-76. 5 fig, 2 tab.

Since April 1970, an investigation was performed by the Los Angeles County Sanitation District and their 380 mgd Joint Water Pollution Control Plant. The Los Angeles Regional Water Quality Control Board had set new discharge requirements that a minimum of 95 percent of the suspended solids in digested sludge be removed. Pilot plant studies showed that five conditioning-dewatering systems were capable of meeting these discharge requirements. An economic evaluation of each alternative was made, assuming a solids quantity of 390 tons per day. The result was the selection of a two stage centrifugation system. The system uses existing horizontal scroll centrifuges followed by imperforate bowl basket centrifuges. In addition, cationic polymers in the dosages of 4 lb/ton were added to the influent of the second stage unit. Disposal will be facilitated by a sanitary landfill, where the composite cake from both units will be hauled by truck. Costs of the total system are predicted to be $36.40 per ton.

*Dewatering, *Requirements, *Sludge treatment, *Suspended solids, Centrifuges, Sanitary landfills, Sludge disposal, Pilot plants, Conditioning, Costs

Los Angeles (Calif.), Waste discharge, Sludge dewatering

D082
PRESSURE FILTRATION--MUNICIPAL WASTEWATER SOLIDS, CEDAR RAPIDS, IOWA,

Gerlich, J. W.

Howard R. Green Company,
Cedar Rapids, Iowa

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 77-85. 5 fig, 1 tab.

Cedar Rapids, Iowa has the first major installation in the United States using the pressure filter for its dewatering process. Fly ash in pilot dewatering studies was shown to be effective in reducing chemical conditioning costs from twenty to four dollars per ton of dry solids. A nine month study evaluated full scale plant performance where sludge cake incinerator ash was utilized as a conditioning agent. Economic evaluation found that the process offered a distinct advantage over other forms of sludge dewatering for Cedar Rapids' sludge. Cake quality on the full scale plant was maintained over a broader range of solids concentrations than was expected. The product of pressure filtration is an increase in solids concentration in the cake with a decrease in suspended solids content in the filtrate. Advantages of pressure filtration include: quantities of sludge conditioners are usually reduced; filtration efficiency is maintained for a broad range of sludge characteristics; solids content of the filter cake is increased; filtrate suspended solids and BOD are very low; operation and manpower requirements are minimal; and cake disposal is convenient due to lower moisture and smaller volumes.

*Filtration, *Dewatering, Sludge treatment, Conditioning, Costs, Fly ash, Filtrate

Pressure filtration, Cedar Rapids (Iowa), Filter cakes

D083
HEAT TREATMENT AND INCINERATION,

Mayrose, D. T.

Dorr-Oliver Incorporated,
Stamford, Connecticut

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 87-91. 4 fig, 3 tab, 1 append.

Heat treatment, in combination with dewatering, is one alternative for treatment of municipal sludge. Heat treatment is the heating of waste sludges to 400 F, and maintaining this temperature for about thirty minutes. It results in a sludge with greatly improved dewaterability characteristics and drier cakes when dewatered. Illustrations compare dewatering heat treated sludge and chemically conditioned sludge. Advantages of heat treatment over raw chemically conditioned sludge include: twice the cake solids concentration in the dewatering unit is possible with heat treatment, as well as double the cake solids capacity of the dewater device; significant reduction or elimination of chemical condition agents can be achieved; when combined with combustion, a smaller incinerator can be used due to lower feed cake water content; and, no fuel will normally be needed for incineration due to the ratio of volatile matter to water in the dewatered heat treated sludge. The process of incineration of biological sludges is also discussed. This may be alone or in combination with heat treatment. When used together, heat treatment and incineration improve the economics of sludge disposal by improving dewaterability as well as reducing or eliminating chemical conditioning agents and the need for auxiliary fuel.

*Heat treatment, *Incineration, *Dewatering, Sludge treatment, Biological treatment

Sludge cakes

D084
DRYING OF SLUDGE FOR MARKETING AS FERTILIZER,

Garrett, M. T., Jr.

Houston Sewage and Sludge Disposal Plant,
Houston, Texas

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 93-95, 3 fig, 2 ref.

The use of the activated sludge process and the subsequent drying and marketing of solids removed as fertilizer are discussed. In order to produce a marketable fertilizer, the nitrogen content must be kept as high as possible. This involves drying activated sludge so as to minimize the moisture, ash, grease, and cellulose. Costs to the buyer include freight costs on the total weight of the material, which in effect determine whether or not the sale is profitable. Sludge treatment processes at Houston, Texas are described. For the City of Houston, the revenue from selling fertilizer is about $21 per ton.

*Fertilizers, *Sludge treatment, Activated sludge, Drying

Houston (Tex.), Marketable dried sludge

D085
RECENT SANITARY DISTRICT HISTORY IN LAND RECLAMATION AND SLUDGE UTILIZATION,

Halderson, J. L., Lynam, B. T., and Rimkus, R. R.

The Metropolitan Sanitary District of Greater Chicago, Chicago, Illinois

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 129-133.

Three major treatment plants handle the flow of sewage sludge in the area around Chicago in Cook County, Illinois. The sludge processed by an air dried method has the best nitrogen:phosphorus:potassium ratio for land utilization. The organic content of this air dried sludge is essentially humic matter, with an importance to the agricultural community in rebuilding topsoil. With the use of this sludge, land has been reclaimed in seven experimental projects. These occurred at the Northwestern University Campus land, at Ottawa, Illinois, Hanover Park, Calument Farm, at the Palzo Project in the Shawnee National Forest, at the Arcola Project, and at the Elwood Agronomy Research Center. One significant result of the research is an indication that application of freshly digested sludge can inhibit seed germination. If, however, the sludge is applied about one week prior to planting or if the sludge has been lagooned for a long enough time, germination is normal. In 1970, the Sanitary District of Chicago purchased land in Fulton County, Illinois, about 200 miles away from the sludge treatment facilities. Sludge is transported there by barge down the Illinois River, and the system of distribution, application, and subsequent cropping is described. Future plans for the Fulton County site and elsewhere include leveling and reclaiming unproductive land, as well as adding organic matter from sewage sludges to sites of strip mine spoils.

*Treatment facilities, *Sludge disposal, Nutrients, Irrigation, Agriculture, Experimentation, Land reclamation

*Land application, Air dried sludge, Chicago, (Ill.)

D086
SLUDGE MANAGEMENT IN ALLEGHENY COUNTY,

Cosentino, R. M.

Department of Public Works, Allegheny County, Pennsylvania

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 135-138. 6 ref.

In the Allegheny County, Pennsylvania, area, solid waste management and sludge management are closely linked. Information is given about current practices. All new applicants for treatment facilities must provide data to the Pennsylvania Department of Environmental Resources as a regulatory agency. The information includes: type of sludge and its physical characteristics; groundwater or water quality management module, with maps required; general site information, including drainage characteristics of surface water, private water supplies located in the area; and methods of operations, including quantity of sludge to be deposited; frequency and method of spreading; and provisions for adverse weather handling and storage. A feasibility study is being planned for a project of restoration of strip mine lands using municipal treatment plant residues and fly ash. Another research project planned by Allegheny County is processing of dewatered undigested sludge produced at the Pine Creek water pollution control facility.

*Sludge disposal, *Treatment facilities, Fly ash, Municipal wastes, Solid wastes, Waste management, Planning, Legislation

Allegheny County, (Pa.), Sludge management

D087
TRENCH INCORPORATION OF SEWAGE SLUDGE,

Walker, J. M.

Biological Waste Management Laboratory,
Agricultural Research Service,
U.S. Department of Agriculture,
Beltsville, Maryland

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 139-149. 4 fig, 4 tab, 5 ref.

The Blue Plains Plant, which serves much of the metropolitan Washington, D.C. area, has had serious sludge disposal problems. In order to discharge secondary effluents into the Potomac River, BOD requirements had to be reduced. This reduction, by the use of ferric chloride or alum, increased the quantities of sludge produced, which necessitated additional sludge disposal. A research and demonstration study was undertaken to evaluate the trenching of raw and digested sewage sludge to improve marginally usable agricultural soils and to provide an environmentally and politically acceptable solution to sludge disposal. Field testing of the procedures in all weather, drainage control evaluation, monitoring of nitrogen, pathogens, and heavy metals in groundwater and surface waters, as well as supporting laboratory and greenhouse studies were conducted. The most likely difficulty was that nitrogen from the sludge might reach underground water. This problem could be minimized by underdraining the entrenchment site and retaining the drained water for irrigating the surrounding land. Entrenchment prevented contamination of surface water, buried pathogens, promoted slow nitrogen release, and favored denitrification.

*Sludge disposal, *Waste water treatment, Sewage sludge, Agriculture, Nitrogen, Drainage, Municipal wastes

Entrenchment, Blue Plains (Washington, D.C.), Trench incorporation

D088
OCEAN DISPOSAL EXPERIENCES IN PHILADELPHIA,

Guarino, C. F., and Townsend, S.

Philadelphia Water Department,
Philadelphia, Pennsylvania

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 151-155.

From 1961 to May, 1973, the city of Philadelphia had been disposing of its sewage by barge to an area 13 miles off Cape Henlopen, Delaware. In 1972, the United States passed the Marine Protection, Research, and Sanctuaries Act, which effected a permit system whereby the dumper would have to meet specific requirements. The permit received by Philadelphia required that a new site be chosen 50 miles off the coast, that an expanded cost analysis be conducted, and that monitoring be continuous at the new location. Another provision of the Act requires that the City determine the sources, relative contributions, and controllability of heavy metal sources within the City's drainage area. At present, Philadelphia sludge exceeds the criteria for mercury and cadmium as defined by the Act. However, there is a conflict as to whether the laboratory analysis is accurate (its range is large) and whether or not the criteria are too stringent. Another problem is the interaction of wastes within a disposal area. Because Philadelphia was required to dump 50 miles offshore, a nearby disposal for acid wastes may be interacting with the sludge to cause flocculation. Alternatives to ocean disposal are three to four times more costly to the City, and land disposal requires a continually increasing amount of land space. Concern was expressed that the Marine Pollution Act should not overcontrol or create new problems. However, the regulation has prompted research into new areas of knowledge of sludge disposal.

*Sewage disposal, *Legislation, Metals, Ocean disposal, Sewage sludge, Regulation, Mercury, Cadmium

D089
SLUDGE DISPOSAL BY INCINERATION AT ALCOSAN,

Brinsko, G. A.

Allegheny County Sanitary Authority,
Pittsburgh, Pennsylvania

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 157-161. 5 fig, 3 ref.

The Allegheny County Sanitary Authority, or Alcosan, has controlled the problems of sludge treatment and disposal for the Pittsburgh area since the middle 1940's. It was decided in 1945, rather than to discharge wastes into the rivers, that incineration would be used for final sludge disposal. Facilities from 1959 to 1973 provided intermediate treatment only slightly better than primary. Final disposal was accomplished in C. E. Raymond Flash-Drying incinerators. In 1973, modernization occurred, whereby the present incinerators are evaporators of water. This method of disposal has caused many problems, and is extremely costly. Thirty-seven percent of Alcosan's operating budget is related to the incinerator operation and fifty percent of their overall maintenance budget goes towards up-keep of incinerators. Odors from the incinerators have caused severe public reaction. Hydrogen peroxide has so far proven to be the most effective chemical in combatting this problem. In addition to odors, incineration of primary and waste activated solids together has created the problem of an increased heat value of the sludge. This raises combustion chamber temperatures from 1650 F to 1900 F and causes slagging. The accumulated slag must be removed, resulting in a loss of furnace time. A new duct system may alleviate this situation. In spite of the problems associated with incineration, the mothod of was chosen because of lack of land availability and the fact that the Pittsburgh sludge is too low in nitrogen to reclaim the material as fertilizer. An alternate solution might be to incinerate both sewagee and solid waste materials together for the generation of steam as a profitable by-product.

Sludge treatment, Incineration, Sludge disposal, Odors, Costs, Waste disposal, Public rights, Combustion, Solid wastes

Alcosan, Pittsburgh (Penna.)

D090
PASTEURIZATION OF LIQUID DIGESTED SLUDGE,

Stern, G.

National Environmental Research Center,
U.S. Environmental Protection Agency,
Cincinnati, Ohio

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 163-169. 1 fig, 4 tab, 7 ref.

Liquid digested sludge, when applied to land for final disposal, may contain pathogens such as viruses, bacteria, cysts or oocysts or protozoa and worm eggs. No direct evidence has been found that stabilized sludges have caused disease to man or animals. However, concern of health officials that these pathogens be completely destroyed has led to laboratory investigations on the effects of pasteurization of liquid digested sludge as a method of disinfection. In West Germany, the practice of pasteurization is used when sludge is spread during the summer growth season. The National Environmental Research Center in Cincinnati, Ohio, tested for pasteurization time/temperautre relationships, types and amount of fuel sources and heat required, the transfer and dispersion of heat with liquid sludge, types of equipment, and estimated costs of the pasteurization methods. It was concluded that pasteurization at 70 C for 30 to 60 minutes destroys pathogens effectively. Methane gas from anaerobic digestion is available as a fuel source, with direct steam injection and efficient mixing of steam and liquid sludge recommended. The costs were about ten dollars per ton of sludge solids for small plants. Studies also showed that pasteurized sludge can be applied to growing lawn grasses as long as the sludge has been cooled to 60 C at the soil surface.

*Sludge disposal, *Pathogens, *Pasteurization, Sludge treatment, Digestion, Viruses, Bacteria, Public health, Laboratory tests, Soils

*Land application, Liquid digested sludge

D091
SLUDGE HANDLING AND DISPOSAL AT BLUE PLAINS,

Cassel, A. F., and Mohr, R. T.

District of Columbia Department of Environmental Services,
Washington, D. C.

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 171-176. 3 fig, 2 tab.

The past, present, and future problems of sludge handling and disposal at the Blue Plains Wastewater Treatment Plant in the Washington, D. C. area are described. The plant is currently being expanded with the addition of advanced waste water treatment. Previously, anaerobically digested sludge was completely disposed by land application. Presently, both raw and digested sludge undergo disposal by a variety of techniques including land spreading, burial, composting, and thermal dehydration. New alternatives, including the processing of sludge into a reusable commodity, are being studied to work within regulatory guidelines. A multi-faceted disposal method that is not totally subject to weather or to biological and chemical upsets is desired. Options to consider for future sludge disposal are enumerated. These are: all raw sludge disposal, thermally dehydrated, marketed as fertilizer; a combination of raw sludge which is thermally dehydrated for fertilizer and digested sludge disposed of on land or composted, whereby methane from the digestion is used as fuel for drying; a combination of raw sludge which is incinerated with digested sludge disposed of on land or composted; and the incineration of completely raw sludge. These options will be tested by an EPA-D.C. pilot plant in the near future, taking into account factors of energy availability as well as specific problems of each alternative method.

*Sludge treatment, *Sludge disposal, Treatment facilities, Land use, Dehydration, Incineration, Guidelines, Fertilizer, Energy, Pilot plants

*Composting, Blue Plains Treatment Plant (Washington, D. C.), Land application, Thermal dehydration

D092
ENERGY CONSERVATION AND RECYCLING PROGRAM OF THE METROPOLITAN SEWER BOARD OF THE TWIN CITIES AREA,

Bergstedt, D. C.

Director of Solids Processing,
St. Paul, Minnesota

In: Proceedings of tha National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 187-194. 8 fig.

Recent actions of the Metropolitan Sewer Board of the Twin Cities Area in response to the 1973 energy problems are described. The Board is the regional treatment authority for waste water in the area of Minneapolis and St. Paul, Minnesota and operaties 24 treatment plants. Ten major programs have been instituted related to energy saving and recycle, without detriment to the quality of waste water treatment. Major changes include: pyrolysis of municipal refuse to furnish heat value for sludge drying; recovery and beneficial use of heat in exhaust gases from incinerators; continuous pressure dewatering; flameless odor control; and improved results by the modification of existing sludge processing equipment. Additionally, the operations include manufacture of fuel-grade sludge cake and char; preparation of fertilizer, soil conditioner and recyclable metal scrap, use of solid fossil fuel, such as coal, to augment combustion in incinerator furnaces; manufacture of activated carbon for in-plant use; and pulping of refuse fibers for use as filter aid. The important factor in choice of these alternatives for energy conservation and recovery is the reliability of a chosen method.

*Energy, Sewage treatment, Sludge treatment, Sludge disposal, Recycle, Conservation, Treatment facilities, Incineration, Equipment, Operation, Fertilizers, Water reuse

Sludge recycling, St. Paul (Minn.), Minneapolis (Minn.)

D093
SLUDGE DISPOSAL AT A PROFIT?,

Fassell, W. M.

Resource Recovery Systems Division,
Barber-Colman Company,
Irvine, California

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 195-204. 7 fig, 6 tab, 16 ref.

The application of hydrometallurgical wet oxidation practice to the destruction of sewage sludge has been investigated. A system has been developed by the Resource Recovery Systems Division of Barber-Colman called the PURETEC/WETOX Process. The system uses an agitated horizontal, multiple-compartment autoclave. The reactor operates under mildly acid conditions and achieves 75 to 85 percent destruction of the COD in any sewage sludge at 440 to 465 F and 600 psi. Substantial quantities of thermal energy are generated; nitrogen compounds are converted to ammonia which is recoverable. Metals, which now are in short supply, are extractable. The predominant organic compound in the resultant solution is acetic acid, which may be used as a carbon source for denitrification. Economic evaluations of the PURETEC/WETOX system are given, in theory, for Philadelphia and for the Blue Plains Wastewater Treatment Facility (Washington, D. C.). With "credits" for reusable materials as by-products of the system, costs may be reduced from the traditional sludge disposal costs of $25 to $47/ton to between $10/ton and a theoretical net operating credit. Within the next calendar year, pilot plants for large scale demonstration of the wet oxidation system will be in operation.

*Oxidation, *Sludge disposal, *Sludge treatment, Costs, Energy, Thermal energy, Organic compounds, Recycle

*Wet oxidation system, PURETEC/WETOX System

D094
SLUDGE MANAGEMENT FOR ST. LOUIS,

Mattei, P. F.

Metropolitan St. Louis Sewer District,
St. Louis, Missouri

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 205-210.

A description is given of the two types of solids handling systems of the Metropolitan St. Louis Sewer District, each for a major subdistrict. The two systems are based on the individual needs of their watersheds. Anaerobic digestion with storage basins was chosen for a secondary treatment plant at Coldwater Creek. The plant services an area of 41 square miles, with a design average flow of 25 mgd. The two Mississippi River subdistrict plants--Lemay and Bissell Point--provide primary treatment for an average design flow of 424 mgd and serve a watershed of 196 square miles. Vacuum filtration, incineration and ash storage basins were selected for these larger subdistrict plants. Because of the disposal methods chosen for Lemay and Bissell point, the land requirement was significantly reduced. The smaller plant at Coldwater Creek, on the other hand, had adequate land for storing digested sludge, and methane gas from the digestion process provided energy to drive blowers and pumps at an economical cost for the secondary treatment process. Each system is well-adapted to its individual watershed location.

*Sludge treatment, *Watersheds, *Anaerobic digestion, Incineration, Secondary treatment, Vacuum filtration, Storage, Treatment facilities

*Land requirements, Solids handling, St. Louis (Mo.)

D095
PHOSPHORUS REMOVAL DEMONSTRATION STUDIES AT C.F.B. TRENTON,

Stepko, W. E., and Shannon, E. E.

Wastewater Technology Centre,
Environmental Protection Service,
Environment Canada

Environment Canada Technology Development Report EPS 4-WP-74-9, September, 1974.
35 p, 14 fig, 12 tab, 7 ref.

Full scale phosphorus removal studies, employing alum addition to an activated sludge treatment plant, were conducted at Canadian Forces Base (C.F.B.) Trenton. Treatment plant performance was closely monitored with respect to BOD5, total phosphorus, and suspended solids removals, under baseline conditions, and at various alum addition levels. The required alum dosage for phosphorus removal was 3.0 to 3.5 mg/liter as Al and the most effective addition point was at the exit end of the aeration basins. Alum additions improved suspended solids removal efficiencies and maintained BOD5 and turbidity removal efficiencies at baseline levels. During periods of zero alum addition, a residual phosphorus removal effect was observed. An in-depth investigation of this effect was recommended to determine if phosphorus removal requirements can be met at reduced alum dosages. Digester capacity was inadequate and digester supernatant quality was poor, so that 70% of the phosphorus removed from the plant in the raw sludge eventually recycled back to the primary clarifier. A proposed solution to this problem was the addition of a second digestion stage to the plant.

*Alum, *Activated sludge, Treatment facilities, Canada, Monitoring, Biochemical oxygen demand, Suspended solids, Digestion, Waste treatment

*Phosphorus removal

D096
UPGRADING EXISTING WASTEWATER TREATMENT PLANTS-CASE HISTORIES,

Environmental Protection Agency Technology Transfer Seminar Publication, August, 1973.
20 p, 11 fig, 6 tab.

Case histories are presented which relate to upgrading the performance of activated sludge and trickling filter plants through modification of the biological processes. In these processes, the biochemical reaction rates depend on the concentration of the wastes and on the appropriate microorganisms capable of feeding on the wastes. Inadequate hydraulic-retention or contact time and solids retention time are the factors which may limit the actual plant performance to a less than optimum level. In addition to the case histories, an outline is presented which lists the process modification or addition and when to use it. The process modifications include: tightening process control; adding final tank capacity; increasing aerator solids level; increasing air supply or improving air distribution; increasing contact time; dividing the reactor into multiple compartments in series; contact stabilization; step aeration; completely mixed activated sludge; positive ventilation; media change; increasing recirculation; activated sludge recirculation; high rate trickling filters; activated sludge; and, a nitrification trickling filter.

*Waste water treatment, *Activated sludge, *Trickling filters, Facilities, Nitrification, Biological treatment, Retention

Hydraulic-retention, Environmental Protection Agency

D097
SURVEY OF WASTEWATER DISCHARGE,

Pauls, C. F., and Thomas, J. F.

United States Air Force,
Kelly A.F.B., Texas

USAF Environmental Health Laboratory Technical Report AD784785, July, 1974. 8 p, 2 ref, 4 append.

A survey of waste water discharge at Campion AFS, Alaska, was conducted between June 27 and June 29, 1973 by the USAF Environmental Health Laboratories of Kelly AFB Texas. Most of the waste waters from Campion are discharged to a sanitary sewage treatment. Secondary treatment of domestic waste water generated by 130 persons is provided by a Model B-Oxigest package treatment system. Water pollution monitoring was evaluated in order to comply with water quality criteria of Alaska. In addition, industrial operations which generated waste water were investigated. With the exception of waste brines generated by a water softening plant, non-domestic or industrial sources of pollutants were found to be insignificant. Although Campion AFS had no records of former sewage treatment plant performance and had conducted no previous laboratory testing of effluent water quality, the sewage treatment outfall proved to be clear and showed no evidence of undesirable conditions. It was recommended that water quality be monitored, and that sampling be conducted of the sewage treatment system to assure future water quality control.

*Waste discharge, Water quality control, Surveys, Waste disposal, Domestic wastes, Waste water treatment, Sewage treatment, Water quality standards, Monitoring, Sampling, Secondary treatment

Campion AFS, Alaska, Model B-Oxigest Treatment

D098
WASTEWATER TREATMENT FACILITY EVALUATION,

Pauls, C. F.

U.S.A.F. Environmental Health Laboratory,
McClellan Air Force Base, California

U.S.A.F. Environmental Health Laboratory Professional Report No. 74M-1, January, 1974. 85 p, 6 fig, 18 tab, 6 append.

A survey was performed of the Malmstrom, Montana, AFB waste water treatment facility. Its objectives included: documentation of existing flow rates; determination of treatment efficiencies for BOD5 and suspended solids removal; analysis of influent waste stream chemical composition to determine if toxic substances limited biomass growth on trickling filters; evaluation of the quality of operation control; and evaluation of laboratory procedures used for waste water analysis. During the survey period the total daily flow treated averaged 0.89 mgd. The Malmstrom AFB waste water treatment facility did not remove a sufficient quantity of BOD and suspended solids to meet secondary treatment standards set by the Environmental Protection Agency. No toxic chemicals were found in the influent waters, however. The facility's treatment inefficiency was not attributed to a single factor but to a combination of inconsistent operational control, poor maintenance, and inflexible design. Several specifications of the treatment facility are detailed which must be improved to meet both existing water quality requirements and future performance conditions to be set forth in the newly required NPDES discharge permit of the Environmental Protection Agency.

*Surveys, *Waste water treatment, *Flow rates, Suspended solids, Biochemical oxygen demand, Water quality standards, Waste disposal, Planning

Environmental Protection Agency, Malmstrom AFB (Montana)

D099
PHYSICAL-CHEMICAL NITROGEN REMOVAL WASTEWATER TREATMENT,

EPA Technology Transfer Seminar Publication, July, 1974. 24 p, 10 fig, 24 ref.

Three basic physical-chemical nitrogen removal techniques are available for the treatment of waste water. These are: ammonia stripping, selective ion exchange, and breakpoint chlorination. Each approach has the advantage of being based on the removal of nitrogen in ammonia form, eliminating the cost of converting the ammonia to nitrate in the biological treatment step. The techniques are also unaffected by toxic compounds that might disrupt the removal system. All three methods are predictable in performance, and space requirements for the treatment units are less than for biological treatment units. The ammonia stripping process has the advantages of low cost, ammonia removal with minimal dissolved solids addition, simplicity, and reliability. It performs poorly in cold weather and concern has been expressed over ammonia gas discharge. The selective ion exchange process has the advantages of high efficiency, insensitivity to temperature, ammonia removal with minimal dissolved solids addition, and elimination of nitrogen discharges to the atmosphere. Costs of this process are high, and process control and operation are complex. Breakpoint chlorination has low capital costs, high reliability, temperature insensitivity, and releases nitrogen as nitrogen gas. Its disadvantages are the addition of a substantial amount of dissolved solids to the effluent to remove ammonia, public concern over chlorine gas handling, and complex process controls. Costs and applications are discussed for nine United States cities.

*Nitrogen, *Waste water treatment, Ion exchange, Chlorination, Ammonia, Costs, Municipal water

*Physical-chemical treatment, *Nitrogen removal, Ammonia stripping, Selective ion exchange, Breakpoint chlorination

D100
PHOSPHATE REMOVAL IN AN ACTIVATED SLUDGE FACILITY,

Finger, R. E., Mason, G. J., Carlson, D. A., and Minton, G. L.

Municipality of Metropolitan Seattle,
Seattle, Washington

National Technical Information Service Report No. PB 235-749, August, 1974. 92 p, 23 fig, 17 tab, 132 ref.

Both the biological and the chemical means of phosphorus removal were studied for the activated sludge facility at Seattle's Renton, Washington plant. Tests were conducted on secondary activated sludge, from jar tests to full scale plant investigation. Results indicate that the observed removal of phosphorus in this soft water area activated sludge facility is mainly biological. Careful control of organic loading rates, air application rates and excess sludge wasting rates can increase removal somewhat. However, even under optimal conditions, the biological mechanism does not consistently reduce the phosphorus concentration to a desired 1.0 mg/liter. Both ferric chloride and alum can effectively remove the phosphorus, and are controlled by automation. Sludge is produced with the addition of either alum or ferric chloride, with the former causing a denser final sludge. Capital costs for either chemical are the same, but alum requires a larger storage tank area. It was also recommended that the use of polyelectrolytes in conjunction with alum or ferric chloride be investigated.

*Activated sludge, *Alum, *Ferric chloride, Phosphorus, Biological treatment, Chemical treatment, Sludge

*Phosphorus removal

D101
THE WELLAND CANAL WATER QUALITY CONTROL EXPERIMENTS (PHASE II),

Shannon, E. E., Ludwig, F. J., Vachon, D. T., and Munawar, I. F.

Wastewater Technology Centre, Environmental Protection Service, Environment Canada

Environment Canada Report EPS 4-WP-74-10, October, 1974. 59 p, 12 fig, 10 tab, 15 ref, 3 append.

The completion of a Fifth Welland Canal bypassing the City of Welland, Canada, left the Fourth Welland Canal as an essentially stagnant body of water. Two alternative methods of controlling water quality problems in the canal were suggested; maintaining a flow of water at about 14.2 cu m/sec through the central and southerly reaches by a system of syphons or treating the standing water in the central and southerly reaches with alum to precipitate phosphorus. Earlier experimentation had demonstrated the feasibility of full scale alum treatment of the water. The details of the full scale alum treatment (dosage of 2.5 mg/liter as Al) are presented. It was found that full scale alum treatment was successful in maintaining acceptable water quality over the period of May 1973 to March 1974. The alum treatment produces some immediate (less than one hour) effects, such as, significant increases in water transparency, decreases in turbidity and total phosphorus and slight decrease in pH. Algal enumeration and denitrification studies confirmed that alum treatment was effective in controlling algal biomass. Zooplankton data suggests that alum or sodium aluminate treatment will not harm natural zooplankton populations. The actual cost of treating the central and southerly reaches of the Fourth Canal in 1973 at an alum dosage of 2.5 mg/liter as Al was $16,471, or $90/acre of water surface.

*Water quality control, *Alum, *Stagnant water, *Water pollution control, Costs, Phosphorus, Canals, Waste water treatment, Aquatic life

D102
COMPREHENSIVE SURVEY OF MAGPIE CREEK,

Pauls, C. F., and Doane, T. R.

United States Air Force,
McClellan Air Force Base, California

USAF Environmental Health Laboratory Professional Report No. 73M-2, April, 1973. 53 p, 12 fig, 12 tab, 5 ref, 3 append.

A survey of the McClellan AFB domestic sewage treatment plant was conducted. A study was made of the stream water quality of Magpie Creek, which flows through the base and carries the effluents of McClellan Base's domestic and industrial waste treatment plants. The stream was sampled both biologically (qualitatively) and chemically (quantitatively). Based on studies on the benthic macroinvertebrates found, the stream shows improved quality upon leaving the base as compared to where it enters the base. The McClellan AFB domestic treatment plant effluents are regulated by the State of California as to BOD concentration, settleable solids, oils, and grease; the survey showed that the Base was within specified limits for all these constituents. Industrial discharges into Magpie Creek, from all industries, were also within water quality standard requirement limits. However, an Industrial Waste Treatment Facility, not yet completely installed, does not have sufficient operational control. In addition, several pipes, sink drains, floor drains and pipe drains have outlets discharging directly into Magpie Creek, from unknown origin. It was strongly recommended that these lines be rerouted to the sanitary or industrial waste sewerage system. This will prevent any spill of toxic materials to the now acceptable waters.

*Surveys, *Domestic water, Sewage treatment, Treatment facilities, Streams, Effluents, Waste disposal, Sampling, Water quality standards

Magpie Creek (Calif.), McClellan AFB

D103
AN EVALUATION OF WATER REUSE FOR MUNICIPAL SUPPLY,

Dworkin, D., and Baumann, D. D.

Butler University,
Indianapolis, Indiana,
Holcomb Research Institute

U.S. Army Engineer Institute for Water Resources Contract Report 74-11, December, 1974. 265 p, 31 fig, 33 tab, 6 append.

A simulation model for evaluating the economic efficiency of water reuse is given. This is applicable to a single community for planning its possible recycling system. Two problems related to low community adoption of water reuse are the unavailability of such a method to assess the relative value of reuse and the professional biases of consulting engineers and public health officials. The use of renovated waste water in water supply planning is illustrated by the example of Colorado Springs, Colorado. A simulation model gives a plan as well as an alternative plan for the next fifty years, beginning in 1974. Expected water demand is based on demographic patterns and considers residential, industrial, commercial, municipal, military, and nonpotable use. Costs and benefits are included in the computer models.

*Simulation models, *Municipal water, *Water supply, *Water reuse, Recycling, Systems analysis, Costs, Public health, Engineering, Water demand

Colorado Springs, (Colo.), Economic efficiency

D104
DOMESTIC WASH WATER RECLAMATION FOR REUSE AS COMMODE WATER SUPPLY USING A FILTRATION-REVERSE OSMOSIS SEPARATION TECHNIQUE,

Hall, J. B., Batten, C. E., and Wilkins, J. R.

Langley Research Center, Hampton, Virginia

NASA TN D-7600, April, 1974. 34 p, 3 fig, 9 tab, 17 ref, 2 append.

An evaluation of a combined filtration-reverse osmosis water recovery system was conducted to determine its capability to reclaim domestic wash water for reuse as a commode water supply. The water produced by this system met all chemical and physical requirements established by the U. S. Public Health Service for drinking water with the exception of carbon chloroform extractables, methylene blue active substances, and phenols. This water is considered to be of a quality able to be reused as commode supply water. The filters used to protect the reverse osmosis unit from plugging were not capable of removing particles less than one micrometer in size from the waste water. The process rate of the reverse osmosis unit was degraded approximately 46.9% for 713 gallons of filtered wash water processed. An average of 0.00897 kilowatt-hour per gallon and 0.0639 kilowatt-hour per gallon was needed to process the wash water through the filtration unit and reverse osmosis unit, respectively. Treatment of the processed water with 5 ppm chlorine was sufficient to reduce the microorganisms in the commode tank to zero. However, efficient mixing of chlorine was necessary in order to rapidly inhibit microorganisms in the processed water tank. The viability of a combined filtration and reverse osmosis technique for the reclamation of domestic wash water is established by this evaluation. The reverse osmosis module, if sufficiently protected from plugging by a filter capable of removing solid materials less than one micrometer in size, is a good low energy method for removing contaminants from domestic wash water.

*Waste water treatment, *Reverse osmosis, *Filtration, *Water reuse, Water purification, Chlorination, Water conservation, Water supply, Domestic water, Domestic wastes

D105
WET AIR OXIDATION OF CHEMICAL SLUDGES,

Hudgins, R. R., and Silveston, P. L.

Waterloo University, Waterloo, Ontario, Department of
Chemical Engineering

Canada-Ontario Agreement Research Report No. 12, March, 1974. 79 p, 7 fig, 6 tab, 23 ref, 5 append.

The Zimmermann process, also called Wet Air Oxidation, or simply "wet oxidation" was developed over 20 years ago as a technique for waste disposal. Wet air oxidation was performed on eight Ontario sludges containing phosphorus. Some of the sludges were obtained from primary or secondary clarifiers in which lime, ferric chloride, or alum had been added to precipitate phosphorus. The sludges were oxidized at temperatures up to 550 F in a rocking autoclave; total carbon and total organic carbon values were measured in samples taken during oxidation. Selected total phosphorus and ortho-phosphorus analyses were made on both chemical and non-chemical sludges. The following conclusions were reached: for most sludges at 500 F, a reduction of at least 50% of the TOC was produced by 3 hours exposure to wet air oxidation; mass transfer limitations seemed to be present except in the case of the activated sludges; cations from chemical stabilization of phosphorus seem to catalyze wet air oxidation; the stabilization of phosphorus by prior chemical treatment was slightly reversed by wet air oxidation of the chemical sludges; contradictory evidence of increased and reduced stabilization resulting from wet air oxidation of non-chemical sludges illustrates the need for further studies; sludges containing high levels of chemicals may cause carbonate formation during sludge oxidation; and, recovery of a high yield phosphorus in the form of a residual ash from wet oxidation appears feasible. Further studies are needed to establish the kinetics of wet air oxidation more fully and to provide knowledge of the reasons for changes in solubility during the process.

*Waste disposal, *Sludge disposal, *Oxidation, Phosphorus, Chemical reactions, Waste treatment, Sewage treatment, Municipal wastes, Canada, Foreign research, Sludge

*Wet Air Oxidation

D106
EVALUATION OF MUNICIPAL SEWAGE TREATMENT ALTERNATIVES,

Pacific Northwest Laboratories,
Battelle Memorial Institute,
Richland, Washington

National Technical Information Service Report No. PB 233 489, February, 1974. 411 p, 35 fig, 6 tab, 219 ref, 3 append.

A comparison was made of alternative waste water treatment strategies. Both their costs and environmental effects were considered. Available municipal waste water and sludge treatment processes were selected on the basis of current or projected use in various sized flow regimes. Included were: primary treatment with land disposal of liquid effluents; waste stabilization lagoons; trickling filters with surface water discharge; trickling filters with land disposal; activated sludge with surface water discharge; activated sludge with land disposal; biological-chemical treatment; activated sludge-coagulation-filtration; tertiary treatment; physical-chemical treatment; extended aeration; sludge thickening, chemical conditioning, vacuum filtration, incineration, and landfill; chemical digestion, and ocean dumping by pipeline; and several other options.

*Waste water treatment, *Reviews, *Costs, *Environmental effects, Municipal wastes, Waste disposal, Ocean disposal, Aeration, Sewage treatment

Sanitary landfill

D107
ECONOMIC ANALYSIS OF THE PROCESSING AND DISPOSAL OF REFUSE SLUDGES,

Kos, P., Meier, P. M., and Joyce, J. M.

Curran Associates, Incorporated,
Northampton, Massachusetts

National Technical Information Service Report PB 234 498, July, 1974. 69 p, 29 fig, 5 tab, 48 ref.

The second in a series of technical reports evaluates the economic and technical feasibility of wet systems for residential refuse collection. The major focus of the document is the feasibility of sludge handling and disposal at waste water treatment facilities. These are modified to accept up to 0.5 percent by weight of ground residential refuse in their sewage influents. Using computer simulation techniques, the sensitivity of sludge handling and disposal operations to operating parameters and input conditions is examined. A substantial decrease in the unit cost of sludge handling, on a per ton of dry solids basis, over plants treating sewage alone can be expected. Suitable process chains include gravity thickening, vacuum filtration, and either landfill or incineration.

*Domestic wastes, *Incineration, *Sludge treatment, Waste disposal, Treatment facilities, Waste water treatment, Costs

*Wet systems

D108
PHOSPHORUS REMOVAL STUDY AT THE SARNIA WPCP,

Gray, I. M.

Canadian Ministry of the Environment,
Research Branch

Canada-Ontario Agreement on Great Lakes Water Quality, Research Report No. 14. 20 p, 7 fig, 3 tab.

A research project was conducted by staff of the Research Branch of the Ministry of the Environment at the Sarnia Water Pollution Control Plant from January to June, 1972 to investigate: the effects of ferric chloride dosage, mixing, and hydraulics on the removal of total phosphorus in a primary waste water treatment plant; and, the effects of ferric chloride addition for phosphorus removal on the anaerobic sludge digestion process. The investigation followed a jar test study and a temporary full scale phosphorus study using ferric chloride, which had been conducted previously by the Dow Chemical Company of Canada, Limited. Existing facilities at the Sarnia WPCP are described, and the average process and analytical data obtained are presented. Effects of various dosages of ferric chloride, with and without the addition of polymers, under various mixing and primary clarifier hydraulic conditions are discussed, in terms of phosphorus removal and other effluent quality parameters. Similarly, the effects of the chemical addition on sludge production and anaerobic sludge digestion are presented.

*Sludge treatment, *Treatment facilities, Waste water treatment, Jar tests, Hydraulics

*Sarnia Water Pollution Control Plant, *Phosphorus removal, *Ferric chloride

D109
OCEAN WASTE DISPOSAL PRACTICES IN METROPOLITAN AREAS OF CALIFORNIA,

McFarlane, C. F.

Interstate Electronics Corporation,
Anaheim, California

National Technical Information Service Report No. PB 230 944, February, 1974.
95 p, 12 fig, 15 tab, 26 ref.

The results of a fact-finding survey of ocean waste disposal practices in the Southern California and San Francisco Metropolitan areas of California are presented in this report. The survey is a portion of an extensive study on waste ocean disposal practices in selected areas of the United States. Information was collected by field interviews and survey techniques and was supplemented by literature and data studies. The sum of the information establishes a data base for the development of guidelines and criteria for the control of ocean waste disposal.

*Waste disposal, *Surveys, California, Data collections, Guidelines, Urban areas

*Ocean disposal

D110
IDENTIFICATION OF PROBLEM AREAS IN WATER POLLUTION CONTROL PLANTS,

Azan, K. M., and Boyko, B. I.

Ontario Ministry of the Environment,
Development and Research Group

Canada-Ontario Agreement on Great Lake Water Quality, Research Report No. 15.
41 p, 12 fig, 5 tab, 1 append.

Problem areas commonly encountered in waste water treatment facilities were determined from responses of Water Pollution Control Plant operators to a questionnaire circulated to 162 WPCP's in Ontario. Areas of design, operational problems, operator education, and training needs were studied from the data. General correlations which could be useful in improving plant performance and mechanical operations were examined. Overall responses indicated that the major problem area in WPCP operation is hydraulic overloading. The incidence of hydraulic overloading is independent of plant size; a significant percentage of plants constructed in the last five years are overloaded. Hydraulic overloading affects pumping capacity, grit removal and secondary clarifier operation. Responses also indicated a general need for additional flow measurement devices. In addition, a considerable need for further operator education in plant testing procedures, interpretation and application of laboratory results, waste water treatment processes, safety, and equipment repair was shown.

*Water pollution control, *Treatment facilities, *Canada, Flow measurement, Surveys, Design criteria, Personnel

*Ontario (Canada), Hydraulic overloading

D111
EVALUATION AND DEMONSTRATION OF THE CAPILLARY SUCTION SLUDGE DEWATERING DEVICE,

Lippert, T. E., and Skriba, M. C.

Westinghouse Electric Corporation,
Research and Development Center,
Pittsburgh, Pennsylvania

National Technical Information Service Report No. PB 232 358, March, 1974.
47 p, 30 fig, 5 tab, 3 append.

A device for dewatering waste activated sludge uses capillary suction in a porous belt. The system has been demonstrated on a pilot scale test unit. The device uses capillary action to initially dewater the sludge, which forms a thin sludge cake. This cake is then mechanically compressed in a final step to obtain a still dryer cake. Both dewatering steps are incorporated into a single system endless belt design. Sludge feed capacities from 2.0 to 4.5 lbs/hr sq ft have been demonstrated, using the cake solids at discharges ranging from 15 to 18 percent. Results were obtained with a conditioned waste activated sludge at a coagulant cost of approximately $4.00/ton. The device also has been tested on an anaerobically digested and a mixed primary-activated sludge.

*Dewatering, *Sludge treatment, *Waste treatment, *Capillary action, Anaerobic digestion, Pilot tests, Costs

Sludge drying

D112
WET SYSTEMS FOR RESIDENTIAL REFUSE COLLECTION: A CASE STUDY FOR SPRINGFIELD, MASSACHUSETTS,

Meier, P. M., Kuhner, J., and Bolton, R. E.

Curran Associates, Incorporated,
Northampton, Massachusetts

National Technical Information Service Report No. PB 234 499, July, 1974. 207 p,
37 fig, 34 tab, 26 ref, 2 append.

As the third in a series of technical reports, this document evaluates the economic and technical feasibility of a wet system for residential refuse collection. A case study implementation of the wet systems concept in the Springfield, Massachusetts, urbanized area is detailed. Analyses of the problems of hydraulic transport of ground refuse in the Springfield sewer system; treatment of a modified waste water treatment plant; the impact on resource recovery and conventional solid waste management; socioeconomic, institutional and fiscal ramifications; and a total systems cost analysis showing annual per household costs for refuse and sewage management are given. Implementation of the system on a domestic level, however, is thought to be at least ten years distant, due to unresolved technical uncertainties. A program of further laboratory investigations is recommended.

*Sewerage, *Domestic wastes, Hydraulic conductivity, Costs, Treatment facilities, Planning

*Springfield (Mass), *Wet systems, Refuse collection

D113
A PRELIMINARY ASSESSMENT OF WET SYSTEMS FOR RESIDENTIAL REFUSE COLLECTION,

Meier, P. M., Kulmer, J., and Martel, C. J.

Curran Associates, Incorporated,
Northampton, Massachusetts

National Technical Information Service Report No. PB 234 496, July, 1974. 166 p, 36 fig, 25 tab, 2 append.

The most promising wet system alternative for residential refuse collection is identified. It involves a system using individual household grinders in low density areas, vacuum collection and neighborhood grinders in high density areas, dilute slurry transport of ground refuse in the existing sanitary sewer systems, and joint treatment of refuse and sewage at an expanded treatment facility, including anaerobic digestion for methane generation. However, the economic feasibility of even the most promising alternative is doubtful because of the high cost of grinding. Hydraulic transport of ground refuse in existing sewer systems may be feasible only if both metals and glass are excluded. A conventional collection of the nongrindable and bulky constituents of residential refuse will still be needed, even if on a diminished frequency. Projected costs are also discussed.

*Treatment facilities, *Domestic wastes, Waste disposal, Hydraulic conductivity, Planning, Costs, Sewers, Sewage treatment

*Grinders, Refuse collection, Household grinders

D114
FLOW EQUALIZATION,

Environmental Protection Agency Technology Transfer Seminar Publication, May, 1974. 21 p, 7 fig, 2 tab, 11 ref.

The main objectives of flow equalization basins for municipal waste water treatment plants is to dampen the diurnal flow variation and the concentration and mass flow of waste water constituents. The result is a more uniform loading of organics, nutrients, and other suspended and dissolved constituents to subsequent processes, thus, flow equalization improves the performance of an existing treatment facility and/or reduces the required size of downstream facilities. Equalization of municipal waste water flows can be divided into three categories: equalization of dry weather flows; equalization of wet weather flows from separate sanitary sewers; and, equalization of combined storm and sanitary waste water. Dry weather flow equalization is discussed. The benefits of dry weather flow equalization including the impact on primary settling and on biological treatment are given. The determination of equalization requirements in terms of the determination of required volume, impact of equalization diurnal concentration variation, basin construction, air and mixing requirements, and pump and pump control systems is discussed. The costs of flow equalization vary considerably from one application to another, depending on the basin size, construction, mixing and aeration requirements, availability of land, location of facility, and pumping requirements. Several case histories of flow equalization are presented.

*Waste water treatment, *Municipal wastes, Equalization reservoirs, Flow control, Organic loading, Sewage treatment, Facilities

*Flow equalization

D115
NITRIFICATION AND DENITRIFICATION FACILITIES WASTEWATER TREATMENT,

Environmental Protection Agency Technology Transfer Seminar Publication, August, 1973, Revised February, 1974. 24 fig, 2 tab, 13 ref.

Nitrification and denitrification have long been recognized as occurring in waste water treatment. Nitrification has been considered beneficial because of the oxygen resource that the nitrates provide. The problems of rising sludge in conventional activated sludge and standard rate trickling filter plants have been shown to be due to denitrification. The common way of controlling the problem was to limit nitrification. There has been demonstrated the need for information on how waste water treatment plants can be designed to accomplish nitrification and denitrification. Chapter I of this report discusses the factors affecting nitrification kinetics including denitrification and population dynamics, nitrification kinetics, and oxygen nitrification systems. Chapter II covers the design criteria of nitrification systems in terms of the nitrification and settling tanks. Denitrification tanks, settling tanks, sludge, and effluent quality are discussed in the final chapter. The discussed nitrification-denitrification facilities can achieve 90% removal of total nitrogen from the waste water treated.

*Waste water treatment, *Denitrification, *Nitrification, Oxygen, Sludge treatment, Facilities, Trickling filters

Settling tanks

D116
WASTEWATER FILTRATION DESIGN CONSIDERATIONS,

Environmental Protection Agency Technology Transfer Seminar Publication, July, 1974. 36 p, 12 fig, 2 tab, 23 ref.

The efficiency and cost of filtration are a function of: the concentration and characteristics of the solids in suspension; the characteristics of the filter media and other filtering aids used; the characteristics of the solids in solution in the water filtered; the characteristics of the filter and its method of operation. Filter design involves finding the operational optimum filter-design characteristics and the economic optimum filter design. The factors necessary for the proper design of granular filters for the filtration of secondary effluents are discussed. Emphasis is placed on the differences between water treatment practices and waste water treatment practices which must be considered for the successful design of waste water filters. The following are the design recommendations: the variable hydraulic and suspended solids load in secondary effluents must be considered; a filter that allows penetration of suspended solids is essential to obtain reasonable filter run lengths; the backwash water flow rate should be large enough to fluidize the coarser-sized grains of each component of the filter media; more uniform media sizes are desirable; auxilliary agitation of the media is essential to proper backwashing; the filtration rate and terminal headloss should be selected to achieve a minimum filter run length of 6-8 hrs. during peak load conditions; and, lower filtration rates or lower influent suspended solids may permit the economical use of gravity filters where multiple filters are needed.

*Waste water treatment, *Filtration, *Filters, *Design criteria, Efficiencies, Costs, Water treatment, Separation techniques

D117
PHYSICAL-CHEMICAL WASTEWATER TREATMENT PLANT DESIGN,

Environmental Protection Agency Technology Transfer Seminar Publication, August, 1973, Revised January, 1974. 41 p, 8 fig, 13 tab, 13 ref, 1 append.

Discussed are typical design parameters for the unit processes involved in the physical-chemical treatment of raw wastes, and how the design engineer may determine the design criteria best suited for a particular waste water. Chapter I deals with the selection of coagulant and discusses the classes of coagulants, lime coagulation, alum coagulation, iron coagulation, and a comparison of coagulant costs. Chapter II discusses carbon adsorption in terms of powdered carbon results and column tests. Chapter III covers process design including flow, preliminary treatment, chemical feed, rapid mix, flocculation, clarifier sizing, recarbonation, filtration, granular carbon adsorption, and carbon regeneration. The final chapter details the physical-chemical treatment of small waste flows and covers clarification-filtration-carbon treatment, sludge production, and sludge disposal. Design project descriptions are given of plants in Niagra Falls, N. Y. and Fitchburg, Mass.

*Waste water treatment, *Facilities, *Design criteria, Coagulation, Filtration, Flocculation, Carbon filters, Adsorption

*Physical-chemical treatment

D118
UPGRADING LAGOONS,

Environmental Protection Agency Technology Transfer Seminar Publication, August, 1973. 43 p, 20 fig, 10 tab, 27 ref.

Lagoons are one of the most commonly used secondary waste treatment systems. Waste treatment lagoons can be divided into five general classes depending on the types of biological actions occurring in the lagoon: high-rate aerobic ponds; facultative ponds; anaerobic ponds; maturation or tertiary ponds; and, aerated lagoons. A well-designed lagoon will incorporate physical features that minimize upsets, maintenance, and nuisances, and that maximize operational flexibility, stability, and BOD removal. Physical design features that should be considered include configuration, recirculation, feed and withdrawal variations, pond transfer inlets and outlets, dike construction, supplementation of oxidation capacity, and algae removal. These criteria are all discussed in detail in reference to upgrading existing lagoons. Several examples of upgraded lagoons are presented.

*Waste water treatment, *Lagoons, *Design criteria, Aerated lagoons, Oxidation lagoons, Efficiencies

High-rate aerobic ponds, Facultative ponds, Anaerobic ponds, Maturation ponds

D119
CONTINUOUS BIOLOGICAL DENITRIFICATION OF WASTEWATER,

Sutton, P. M., Murphy, K. L., and Dawson, R. N.

McMaster University, Hamilton, Ontario

Environment Canada Report No. EPS 4-WP-74-6, August, 1974. 242 p, 44 fig, 40 tab, 4 append.

The feasibility of using continuous microbial denitrification for nitrate removal from municipal waste water over a wide range of temperatures was tested by both pilot plant upflow packed column reactors and a stirred tank reactor. The following conclusions were reached: the temperature dependency of the unit denitrification rate can be predicted by an Arrhenius type curve between 5 C and 25 C; the packed column system seemed to be no more temperature sensitive than the stirred tank system in effecting denitrification; an influent nitrified municipal sewage with a concentration of 10-12 mg/liter NO3-N can be completely denitrified in a stirred tank reactor at 5 C in 6 days and in 3 days at 20 C; the unit denitrification rates determined from batch stirred tank reactor studies can be used to predict continuous reactor results at the same sludge age; in the upflow packed column reactor nitrate removal is dependent on the detention time and the packing surface area available for bacterial growth; pilot plant results demonstrated that closed nitrogen balances can be performed on continuous stirred tank reactors and packed column reactors to account for the bacterial conversion of nitrate to nitrogen gas; and, methanol consumption was variable in both the stirred tank and packed column reactors.

*Waste water treatment, *Biological treatment, *Denitrification, Microbial degradation, Nitrogen, Temperature, Municipal wastes, Pilot plants

Nitrogen removal, Stirred tank reactor, Upflow packed column reactor

D120
SOLID WASTE MILLING AND DISPOSAL ON LAND WITHOUT COVER,
VOLUME I. SUMMARY AND MAJOR FINDINGS,

Reinhardt, J. J., and Ham, R. K.

City of Madison,
Madison, Wisconsin

National Technical Information Service Report No. PB-234 930, 1974. 165 p, 53 fig, 35 tab, 7 ref, 2 append.

As the first half of a two-part report, the highlights of seven years work at Madison, Wisconsin, are summarized. A practical demonstration on the concept of milling refuse for landfill disposal without daily cover was tested. The project was intended to gather data on the operation and cost of milling equipment, the use of milled refuse in landfill, and the characteristics of milled refuse. Eventually, project personnel conducted detailed investigations both on milled and unprocessed solid waste. While landfilled milled solid waste, or millfill, was highly approved by European landfill operators, further experiments in Wisconsin were seen as necessary. Design for study included the use of the effects of landfill on rats, flies, leachate, gas, and trees, for quantification of various factors. The second volume of this report enumerates the data found.

*Landfills, Solid wastes, Wastes, Design criteria, Waste disposal

Madison, (Wisc.), Millfill, Sanitary landfill, Land application

D121
SOLID WASTE MILLING AND DISPOSAL ON LAND WITHOUT COVER. VOLUME II. DATA CONDENSATIONS,

Reinhardt, J. J., and Ham, R. K.

City of Madison,
Madison, Wisconsin

National Technical Information Service Report No. PB 234 931, 1974. 445 p, 111 fig, 123 tab, 16 append.

As the second half of a two-part report, this document details individual research projects on the feasibility of milling refuse for landfilling without daily cover. The demonstration projects were conducted between 1966 and 1972. Milling was begun in Europe to provide material suitable for composting. Originally single-rotor or double-rotor hammer mills handled homogeneous materials, necessitating manual sorting of larger, ungrindable items. Automation was discovered in the 1950's and has been used in Europe since. The Heil Company of Milwaukee, Wisconsin, learned of the European system and this led to the installation of a Gondard hamermill at the Madison Refuse Reduction Plant in 1967. Topics detailed in this volume include: the Gondard operation; the Tollemache operation; two-mill, two-shift operations; and the costs of landfilling milled refuse. Vector studies were done of rats and flies at Madison and of rats at Purdue University. Observations were made on products of decomposition-leachate and gas as well as the effects of tree growth and other vegetation on refuse. Sixteen appendices detail the costs and quantities (dollars and tons) for milling and solid wastes at the Gondard and Tollemache operations.

*Solid wastes, Landfills, Costs, Waste disposal, Environmental effects

Millfill, Sanitary landfill, Madison (Wisc.), Hammermill

D122
SEWAGE TREATMENT PLANT DEPENDABILITY WITH SPECIAL REFERENCE TO THE ACTIVATED SLUDGE PROCESS,

West, A. W.

Cincinnati Field Investigations Center, Cincinnati, Ohio,
Sewage Treatment Plant Operation and Design Branch

National Technical Information Service Report PB-231 070, March, 1971. 12 p.

This work is a reference for sewage treatment plant dependability lectures that the author has presented at training sessions, symposia, and workshops. Design considerations necessary to achieve consistently satisfactory plant performance and final effluent quality include the proper treatment processes, a generous plant capacity, essential flexibility, and true controllability of the plant. The treatment process or modification most appropriate to the known waste characteristics and effluent quality requirements should be chosen. Examples include the classic activated sludge process, the complete mix modification and the step aeration modification. Pilot studies on a bench, pilot, or demonstration scale may be performed to resolve uncertainties about the correct process to choose. The suggestions contained in design criteria manuals such as the "10-States Standards" and others shoudl be considered as minimum requirements needed to provide adequate safety factors to assure plant dependability. Items discussed under flexibility of a plant include: process; aeration tanks; final clarifiers; return sludge pumping facilities; excess sludge wasting; emergency chemical treatment; sludge handling facilities; equalizing tanks; and, holding ponds. The activated sludge system is a controllable process that should have the appropriate meters and accurately controllable gates, valves, pumps, and blowers for optimum performance. Qualified operators are needed to achieve the high quality effluent that can be produced by a properly designed waste treatment plant; dedicated, experienced operators are needed even more at plants which have design defects. The author's suggestions are based on first-hand operational experiences at many sewage treatment plants.

*Sewage treatment, *Design criteria, *Operation and maintenance, *Facilities

D123
PHOSPHORUS REMOVAL IN SEASONAL RETENTION LAGOONS BY BATCH CHEMICAL PRECIPITATION,

Graham, H. J., and Hunsinger, R. B.

Canada-Ontario Agreement Research Report No. 13, 1974. 40 p, 15 fig, 4 tab, 14 ref.

A result of a Province of Ontario policy requiring phosphorus removal at municipal and institutional waste water treatment facilities in certain areas of the province is the development of a method of reducing the total phosphorus content in waste stabilization pond effluents to below 1.0 mg/liter. The method of achieving this in seasonal retention lagoons through batch chemical treatment of the pond contents prior to discharge is discussed. The three prime coagulants that were field tested were alum, ferric chloride, and lime. The required chemical dosage was determined by jar tests using lagoon contents. The following conclusions resulted from the information obtained in this project: batch chemical treatment of seasonal retention lagoons can produce total phosphorus residuals of less than 1.0 mg/liter; the quality of the effluent from a batch treated lagoon is at least as good as that achieved through conventional secondary treatment; batch treatment can effectively remove algae from the pond contents if the chemical dosage is sufficient; liquid alum and ferric chloride both produced a high quality effluent; inconsistent results were obtained from the lime applications; good dispersal of the chemical and adequate mixing with the pond contents can be accomplished with an outboard motorboat method of application; batch chemical treatment is feasible on many existing lagoons that have an adequate retention time for winter storage; some single and large cells can also be batch treated but lagoons built specifically for batch treatment ensure ease of operation; and, in five successive treatments of one lagoon, the dosage required for adequate phosphorus removal did not increase and there was only a slight increase in the sediment depth with each treatment.

*Phosphorus, *Nutrient removal, *Waste water treatment, *Water pollution treatment, Chemicals, Sewage treatment, Municipal wastes, Industrial wastes, Coagulation, Lagoons, Lime

*Batch treatment, *Chemical treatment, Alum, Ferric chloride, Ontario (Can), Phosphorus removal

D124
AN EVALUATION OF THE HAGERSTOWN, MARYLAND WATER POLLUTION CONTROL PLANT,

West, A. W., and Touhey, R. J.

National Field Investigations Center, Cincinnati, Ohio

National Technical Information Service Report PB-231 072, November, 1973. 31 p, 1 fig, 8 tab, 1 append.

The City of Hagerstown, Maryland, Water Pollution Control Plant experienced difficulty in maintaining consistent effluent quality between January 1972 and April 1973. Reasons for the difficulties were determined to be severe overloading of the primary clarifiers, high organic loads imposed on the secondary system because of primary system deficiencies, hydraulic overloading of the aeration tanks and final clarifiers during periods of sustained high flow, hampering of the process control by an overall lack of flow meters and controls, inability to feed the flow to the various units to maximize the efficiency of the secondary system, and inability to accurately control the return and waste sludge flows. Recommendations of the representatives of the EPA National Field Investigation Center included these immediate modifications: two rectangular primary clarifiers should be converted into sludge holding/thickening tanks; the circular primary clarifier should be converted into an additional final clarifier; variable speed drive pumps should be provided; meters and control valves should be installed; modification of the circular primary clarifier piping should include plans for its use as a final clarifier; and two blowers should be repaired to provide additional aeration capacity. Long range modification recommendations were for the installation of: separate pumps and meters for excess sludge wasting; meters and valves or gates to measure and control the various sludge, sewage, and liquor flows; a central meter and control panel to permit remote adjustment of valves and pumps; automatic density controllers to aid in sludge handling; and, new primary sedimentation units to replace the inadequate units.

*Waste water treatment, *Water pollution control, *Facilities, *Sewage treatment, Control, Standards, Equipment, Sludge, Clarification, Sedimentation, Pumps, Aeration

D125
THE ROLE OF POLYELECTROLYTES IN FILTRATION PROCESSES,

O'Melia, C. R.

North Carolina University, Chapel Hill, North Carolina

National Technical Information Service Report No. PB-233 271, April, 1974. 81 p, 24 fig, 5 tab, 34 ref.

Research was conducted to determine how destabilizing chemicals act in augmenting the effectiveness of filtration processes and to examine selected applications of destabilizing chemicals in filtration for the treatment of waste water. The chemical destabilization required for effective filtration was found to be similar to that required for effective coagulation. Chemical pretreatment was observed to be necessary for effective filtration of all systems considered in this research. The optimum chemical dosage for a jar test or batch coagulation test is the chemical dosage that will provide the best effluent quality in a filtration process. If polymers are used as destabilizing chemicals, overdosing may occur due to restabilization of the suspended particles. For the cationic polymer series tested, the optimum polymer dosage was independent of the molecular weight of the polymer, but the removal efficiency of filters operated at this optimum dosage increased with increasing molecular weight. When proper chemical pretreatment occurs, conventional filter beds are capable of removing almost all particles applied to them, regardless of suspended particle size. If effective filtration is not achieved, it should be attributed to poor chemical pretreatment. Other conclusions made concern the mechanisms of polymer action in filtration, the results that can be obtained using polymers as filter-aids, and the application of this knowledge of the design of filtration processes for waste water treatment.

*Filtration, *Waste water treatment, *Polyelectrolytes, *Pre-treatment, *Chemical reactions, Polymers, Chemicals, Coagulation, Trickling filters, Particle size, Filters

D126
FULL SCALE PHOSPHORUS REMOVAL STUDIES AT C. F. B. PETAWAWA,

Shannon, E. E., Salvo, J. M., and Burns, B. R.

Wastewater Technology Centre, Environmental Protection Service, Environment Canada, Burlington, Ontario

Environmental Protection Service Report EPS 4-WP-74-3, April, 1974. 45 p, 11 fig, 11 tab, 11 ref, 1 append.

In 1971, the Environmental Protection Service and the Department of National Defence started a program to add phosphorus removal systems to the existing waste water treatment facilities at Canadian Forces Bases (C. F. B.) at Borden, Petawawa, Trenton, and Uplands. In March 1973, full-scale phosphorus removal studies were begun at C.F.B. Petawawa. Conclusions of the study include: the optimum alum dosage for phosphorus removal to remaining levels of one mg/liter or less was determined to be 12.5 mg/liter as Al; alum additions improved the BOD removal efficiency of the primary plant from 35 to 60% and marginally improved suspended solids and turbidity removal; phosphorus balances performed across the plant showed that almost all of the phosphorus removed as primary sludge accumulated in the primary and secondary digesters; after forty days the primary and secondary digesters were still acting as significant phosphorus sinks and had not reached steady-state conditions; alum additions caused a significant decrease in effluent pH and alkalinity and an increase in aluminum and sulphate; a sudden two-fold increase in digester volatile solids loading incurred by alum addition caused a digester failure with the classic symptoms such as an increase in volatile acids, a decrease in pH and alkalinity and a cessation of gas production; and, in general, jar tests predicted full-scale chemical requirements reasonably well.

*Phosphorus, *Waste water treatment, Nutrient removal, BOD, Suspended solids, Turbidity, Chemicals, Chemical reactions, Sludge, Digestion, Canada

*Phosphorus removal, *Alum, Phosphorus sinks

D127
SYNTHETIC AND ACTIVATED CARBON FOR WASTEWATER TREATMENT,

Snoeyink, V. L., Kim, B. R., Hinrichs, R. L., and Jennings, P. A.

Illinois University at Urbana-Champaign, Urbana, Illinois

Air Force Weapons Laboratory AFWL-TR-112, June, 1974. 82 p, 18 fig, 4 tab, 44 ref.

This study examined the feasibility of using synthetic resins in place of or in combination with activated carbon for adsorption processes of waste water treatment systems. An in-depth literature review of the use of resins as adsorbents was followed by bench-scale testing of potentially suitable resins using selected test compounds in single-solute systems as well as various types of activated sludge effluent. It was observed that the choice of resin depends on the type of compounds to be adsorbed. Weak base resins appear to be most suitable for waters which contain a wide variety of organic compounds, such as secondary effluent, many industrial waste waters, and waters containing organic matter of natural origin. Weak base resins not only have the highest capacity and appear to be the most general type of adsorbent for heterogeneous solutions of organic compounds but also seem to have the most favorable properties for regeneration. The adsorption capacity of the resins and the number of species which could be adsorbed by the resins generally appeared to be less than those for activated carbon. Further research needs to be done with resins using the specific waste water to be treated because of the dependence of the performance of the resin on the types of species being adsorbed.

*Waste water treatment, *Adsorption, *Activated carbon, *Resins, Organic wastes, Laboratory tests, Sewage treatment, Municipal wastes, Industrial wastes

Regeneration

D128
CARBON FROM LIGNITE OR COAL: WHICH IS BETTER?,

DeJohn, P. B.

ICI United States, Incorporated, Wilmington, Delaware.

Chemical Engineering, Vol. 82, No. 9, p 113-116, April, 1975. 3 fig, 3 tab, 8 ref.

Granular carbons produced from medium-volatile bituminous-coal or lignite have been found to be the best activated carbons for use in waste water treatment. The factors to be considered when choosing the appropriate type include: ability to absorb enough impurities to meet allowable effluent standard; reasonable losses during carbon regeneration; minimal pressure drop and operating problems; and, lowest operating cost. More than fifty comparative granular carbon studies were performed on various municipal and industrial effluents including those from tertiary municipal treatment, oil refineries, dye plants, and pulp and paper mills. The two types of carbon produced from coal or lignite performed equally well on an equivalent volume basis when treating domestic waste streams. The most important factor that determines the adsorption capacity of a carbon is available surface area. Bituminous-coal carbon has a greater total surface and more surface in the micropore range, while lignite carbon has more surface area in the transitional-pore range. Therefore, a lignite carbon performs better than a bituminous-coal carbon when treating a waste stream containing pollutants with mostly large molecules. Bituminous-coal carbon adsorbs small-molecule pollutants better than lignite carbon because it has more available surface area in the micropore range. However, thermal regeneration destroys the surface area in this range and after several regenerations both carbons perform about the same. Lignite carbons were found to regenerate faster and under milder conditions than bituminous-coal carbons.

*Waste water treatment, *Activated carbon, *Adsorption, Municipal wastes, Industrial wastes, Lignite, Coals

D129
INTEREST IN OXYGEN PROCESS GROWING,

Ward, P. S.

Journal of the Water Pollution Control Federation, Vol. 46, No. 11, p 2449-2451, November, 1974.

The high purity oxygen activated sludge process is becoming an established waste water technique. Detroit, Tampa, and New Orleans are all planning domestic waste water treatment plants utilizing this approach. Food processors, petrochemical manufacturers, and pulp and paper mills have employed the concept with apparent success. Four primary improvements over conventional air systems are claimed for oxygen activated sludge: increased stability; shorter detention times and consequently, more compact facilities, superior sludge characteristics; and, more efficient energy use. The key element in the achievement of this system is the high degree of gaseous oxygen utilization. A high purity oxygen system is capable of a much higher level of oxygen dissolution than is a conventional air system, because the partial pressure of the oxygen in the aeration gas is the driving force for dissolution. The continuously renewed high concentration of oxygen supplied by the system preserves aerobic conditions while maintaining mixed liquor suspended solids concentrations ranging from about 4,500 to 8,000 mg/liter. The richly oxygenated, high MLSS concentration is responsible for the rapid rate of treatment obtained, cushions the process to shock loading, and makes it possible to treat a large volume of waste water in a relatively small facility.

*Waste water treatment, *Municipal wastes, *Industrial wastes, *Activated sludge, Oxygenation, Aeration

*High-purity oxygen activated sludge

D130
OXYGEN ACTIVATED SLUDGE WASTEWATER TREATMENT SYSTEMS--DESIGN CRITERIA AND OPERATING EXPERIENCE,

Environmental Protection Agency Technology Transfer Seminar Publication, August, 1973, Revised January, 1974. 46 p, 14 fig, 13 tab, 3 ref, 2 append.

The use of oxygen in place of air in the activated sludge process as is done in the Unox system is one example of improved technology to aid in pollution control. The primary distinguishing feature of the Unox system is that high purity oxygen is the source of oxygen for the microorganisms in the aeration basin. The Unox system uses a covered and staged oxygenation basin for contact of oxygen gas and mixed liquor. High purity oxygen enters the first stage of the system and flows cocurrently with waste water being treated through the oxygenation basin. Operating data and experience from specific programs is presented including results from treatment of domestic wastes, food processing wastes, pulp and paper mill wastes, textile wastes, metal processing wastes, and chemical and petrochemical wastes. The proper design of a Unox system requires the following basic information concerning the waste to be treated: waste water quantity; waste water quality; effluent quality required; and, definition of the other unit operations or existing facilities in the treatment plant and their relationship to the Unox system. In addition to process design, process safety, the Unox system scope of supply, economics of the system, specifications for final settling tanks, and specifications for oxygenation tanks are also discussed.

*Waste water treatment, *Domestic wastes, *Industrial wastes, *Oxygenation, Activated sludge, Costs, Economics, Aeration, Water pollution control, Design

*UNOX

D131
RATE OF PHOSPHORUS UPTAKE BY ACTIVATED SLUDGE,

Wells, W. N.

Water and Sewage Works, Vol. 122, No. 1, p 36-39, January, 1975. 10 fig, 9 ref.

A method of recycle of phosphorus from waste water is described, utilizing waste activated sludge as the practical stream for phosphorus removal. The rate at which phosphorus is taken up by an activated sludge appears to be an important characteristic of the sludge in phosphorus removal. Determination of the uptake rate has been standardized in the laboratory whereby: a sample of sludge is mixed with primary effluent and aerated; samples are drawn at intervals and filtered through qualitative filter paper; the filtrate is analyzed for orthophosphate; a curve of phosphorus remaining in the filtrate versus time is plotted; and the steepest portion of the curve is taken to be uptake rate in mg/liter/hr. Two criteria for effective phosphorus removal are considered. These are that enough solids be produced and that phosphorus can be incorporated into the sludge. Experiments to condition activated sludge to increase its amount of phosphorus uptake are discussed, particularly those from a San Antonio, Texas, sewage treatment plant.

*Phosphorus, *Waste water treatment, *Recycling, Nutrient removal, Laboratory investigations, Activated sludge, Sewage treatment

*Phosphorus uptake rate, *Phosphorus removal, Waste activated sludge, San Antonio (Tex.)

D132
OPERATION OF FULL-SCALE BIOLOGICAL PHOSPHORUS REMOVAL PLANT,

Levin, G. V., Topol, G. J., and Tarnay, A. G.

Biospherics, Incorporated,
Rockville, Maryland

Journal of the Water Pollution Control Federation, Vol. 47, No. 3, p 577-590, March, 1975. 5 fig, 10 tab, 12 ref.

The first full-scale installation of the Phostrip process of phosphorus removal from waste water, marketed by Union Carbide, is in operation at Seneca Falls, New York. Its beginning thirty days were closely monitored, then this biological process was installed on a permanent basis. The method is based on the use of activated sludge microorganisms to transfer phosphorus from inflowing waste water to a small concentration substream for precipitation. The activated sludge is subjected to anaerobiosis, inducing phosphorus release into the substream and providing phosphorus uptake capacity when the sludge is returned to the aeration basin. Total phosphorus effluents as low as 0.2 mg/liter were obtained in full scale plant operation, a level far below the New York State effluent limit of 1.0 mg/liter. Total costs of phosphorus removal, particularly operating costs, were drastically reduced, as compared to conventional methods.

*Nutrient removal, *Phosphorus, Biological treatment, Treatment facilities, New York, Monitoring, Activated sludge, Microorganisms, Precipitation (chemical), Waste water treatment, Aeration, Operating costs

*Phosphorus removal, *Phostrip, Union Carbide

D133
OZONE CHEMISTRY AND TECHNOLOGY-A REVIEW OF THE LITERATURE: 1961-1974,

Murphy, J. S., and Orr, J. R.

Franklin Institute Research Laboratories,
Philadelphia, Pennsylvania,
Scientific Information Services

The Franklin Institute Press, Philadelphia, Pa. 1975. 392 p.

The worldwide chemistry literature was thoroughly reviewed from 1961 to 1974 for all aspects of ozone chemistry and technology. Eleven state-of-the-art overviews covering nine subject areas comprise the body of the book with over 3,000 bibliographic entries as supportive material. The subject areas include the effects of ozone on vegetation, the effects of ozone on animals, ozone treatment of waste water, ozone in organic chemistry, ozone equipment and instrumentation, ozone involvement in atmospheric chemistry and meteorology, ozone in inorganic chemistry, ozone general chemistry and technical applications, and ozone in polymer chemistry. Thorough subject and author indexes are also included.

*Reviews, *Ozone, *Waste water treatment, Pollutant effects, Publications, Equipment, Instrumentation, Bibliographies, Chemistry, Polymers

Organic chemistry, Inorganic chemistry, Ozonization, Literature reviews

D134
FLUIDIZED-BED INCINERATION OF URBAN SLUDGE (INCINERATION DES BOUES URBAINES EN LIT FLUIDISE),

Tamalet, M.

Revue Generale de Thermique (Paris), No. 150/151, p 511-517, June/July, 1974. 9 fig, 1 tab.

A method and the equipment for the fluidized-bed incineration of urban sewage sludge are described. A sand fraction of 0.5-2.0 mm is used as a fluidized medium. The sewage sludge is injected at the top of the fluidized-bed reactor to obtain lumps about 20 mm in size which then are heated rapidly by the fluidized sand. The prevention of malodorous emissions requires a minimum reactor temperature of 800 C. Incineration takes place in a temperature range of 800-850 C at an excess-air coefficient of 20 percent. The combustion products are carbon dioxide, water, and mineral ashes. The cost of the incineration increases rapidly with increasing water content in the sludge, as does the flue gas volume. The fluidized-bed sludge incineration is simple, economical and efficient.

*Municipal wastes, *Sludge treatment, *Waste water treatment, *Incineration, Costs, Combustion, Urban drainage

*Fluidized-bed incineration, Urban sewage sludge

D135
DISPOSAL OF WASTE ALUM SLUDGE FROM WATER TREATMENT PLANTS,

Gruninger, R. M.

Malcolm Pirnie, Incorporated,
Paramus, New Jersey

Journal of the Water Pollution Control Federation, Vol. 47, No. 3, p 543-552, March, 1975. 3 fig, 5 tab, 4 ref.

The Environmental Protection Agency has classified alum sludge from water treatment plants as an industrial waste which may no longer be discharged to streams. Treatment plants in western New York State have been constructed and are operating plant scale alum sludge treatment units; four such alum sludge dewatering facilities are discussed. Characteristics of the sludges were shown to be affected by the substances used in water treatment and may be highly variable. It was concluded that no single system can economically dewater dilute alum sludge to the minimum acceptable concentration for landfill disposal. An investigation of alternatives indicated that the separation of the solids from alum sludge is best accomplished in a two stage system. The first step should be primary thickening by gravity to achieve a solids concentration of two to six percent total solids by weight. The second stage is mechanical dewatering, achieved through pressure filters, vacuum filters, or scroll centrifuges, obtaining a solids concentration of at least 20 percent total solids by weight.

*Alum, *Water treatment, *Waste treatment, New York, Dewatering, Waste disposal, Land management, Filtration, Separation techniques

Gravity thickening, Environmental Protection Agency, Landfill disposal

D136
AUSTRIAN PLANT KNOCKS OUT NITROGEN,

Matsche, N. F., and Saptzierer, G.

Technical University,
Vienna, Austria,
Department for Wastewater Engineering

Water and Wastes Engineering, Vol. 12, No. 1, p 18-24, January, 1975. 9 fig, 2 tab.

The Vienna-Blumenthal treatment plant in Vienna, Austria uses aeration with mammoth rotors, alternately with oxic and anoxic zones in the cycling mixed liquor, to accomplish nitrification and denitrification. With experiments using differing numbers of rotors, nitrogen removal level has reached up to 85%. The plant has a pumping station, screens, an aerated grit chamber, two aeration tanks, two final sedimentation tanks, and a return sludge pumping station. Waste water is lifted by screw pumps; coarse material is removed by bar screens; sand and floatable materials are removed in the grit chamber. Waste water flows directly to the aeration tanks. Mixed liquor is clarified in two final sedimentation tanks. Effluent flows directly to the receiving stream and the return sludge is pumped back with a constant flow to enter the aeration tank with the raw waste water. Excess sludge is removed from the return sludge by pumping it to the Liesingtal sewer to be treated at Vienna's main sewage treatment plant. Evaluations of construction costs, design data, and efficiency of the operation have been made since 1971. In 1974, different numbers of operating rotors were tested. Removal of excess sludge was held constant. Pollutant loading varies where industries discharge waste water into the system. Three plus three rotors is the normal optimal number for year round operation. NH4-N was determined in laboratory tests; organic nitrogen was estimated as well.

*Treatment facilities, *Aeration, Effluents, Sludge treatment, Construction

D137
CHARACTERISTICS OF GAS-LIQUID CONTACT APPARATUS IN OZONE TREATMENT FOR DRINKING WATER,

Tabata, N.

Suido Kyokai Zasshi, No. 482, p 16, November, 1974. 25 fig, 7 ref.

The chemical and physical behaviors of ozone in drinking water were studied during the construction of an efficient reaction bath for drinking water sterilization by ozone. Experiments were conducted using a 5 m resin tube (15 cm in diameter) with several sampling side tubes at different positions for ozone analyses. The ozone was bubbled from the bottom of the tube and water flowed in with either countercurrent or cocurrent motion against the ozone flow. Analyses of ozone were made by a UV absorption ozonemeter or by iodometry. Drinking water was boiled to exclude the dissolved chloride ion and used. The ozone absorption by water was more efficient in the countercurrent experiment than in the cocurrent experiment owing to a mixing effect. At a constant ozone flow rate, the dissolved ozone concentration increased with increasing reaction path length for the countercurrent experiment. However, the cocurrent experiment gave an increased concentration (1.5 g/cu m) up to 2 m reaction path length, but no further increase in the concentration was obtained with a longer path length. The water flow rate affected ozone absorption in that the increased flow rate decreased ozone absorption for the cocurrent experiment, but increased flow rate for countercurrent experiment, indicating more vigorous mixing between ozone and water. The decomposition constant of ozone was shown to be dependent on water temperature and water qualities.

*Water treatment, *Ozone, *Potable water, Flow rates, Ultraviolet absorption, Flow, Water temperature, Instrumentation

Ozonemeter, Gas-liquid contact

D138
PACKED-BED REACTORS FOR SECONDARY EFFLUENT BOD AND AMMONIA REMOVAL,

Young, J. C., Baumann, E. R., and Wall, D. J.

Journal of the Water Pollution Control Federation, Vol. 47, No. 1, p 46-56, January, 1975. 13 fig, 1 tab, 11 ref.

The use of packed-bed reactors (PBRs) in waste water treatment is reviewed. Results of pilot plant studies are described from investigations conducted: to determine BOD and suspended solids removal characteristics of the PBR-filter system when it is used to polish secondary effluent from biological treatment plants; to determine whether nitrification may be accomplished in PBR units at temperatures below 10 C; to compare the performance and operating characteristics of various PBR media; and, to determine such characteristics of dual-media filters following aerobic PBR treatment of secondary effluents. From several studies, the PBR and dual-media filter systems provided a high degree of polishing for low-quality secondary effluents. Effluent BOD was reduced to below 5 mg/liter. Nitrification was successful throughout cold weather for an entire winter operation. Effluent ammonia nitrogen concentrations averaged less than one mg/liter. Three PBR media--sand, crushed coal, and loosely-packed plastic--gave almost the same BOD and suspended solids removals. Selection of media thus should be related more to design and operational simplicity and cost than to media size and shape. Operation of packed-bed reactors is relatively simple in comparison with operation of activated sludge systems. Comprehensive design criteria for PBR systems for nitrification should be planned utilizing some of the guidelines discussed.

Waste water treatment, Pilot plants, Suspended solids, Secondary treatment, Nitrification

Packed-bed reactors, BOD removal, Ammonia removal

D139
FERRIC CHLORIDE OR LIME FOR CHEMICAL TREATMENT,

Markis, N., Rebhun, M., and Offer, R.

Technion, Israel Institute of Technology,
Haifa, Israel,
Environmental Engineering Laboratories

Water and Sewage Works, Vol. 122, No. 1, p 43-45, January, 1975. 2 fig, 3 tab, 8 ref.

Direct chemical treatment of raw sewage, as primary treatment, followed by biological or physico-chemical treatment has been studied. Chemical flocculation with ferric chloride is compared with lime flocculation according to the parameters of: removal characteristics of mineral constituents, including alaklinity, phosphates and Mg^{++}, and efficiencies of removal of sewage organic materials. Selection of the right flocculant is important in waste water treatment. Conventionally, ferric salts, alum, or lime may be used. While ferric and aluminum salts have positively charged polynuclear hydoxo complexes, lime treatment with a high pH causes the formation of positively charged Mg(OH)2, and CaCO3 precipitate. Hydrolyzing flocculants, such as ferric chloride, were compared with lime depending on: contaminants removal efficiencies by flocculation; water quality of the final effluent; economic feasibility; and, ultimate disposal of sludge. At optimal doses, no significant differences in removal of organics and phosphorous compounds were found, except for hardness and alkalinity. The choice of a flocculant is affected by costs and sludge handling. Lime requirements are higher than ferric salts or alum. Primary sludge from alum or iron can be treated anaerobically while lime sludge must be disposed by thickening, followed by filtration, drying and incineration or by acid dissolving.

*Chemical treatment, *Lime, Ferric chloride, Alum, Sewage treatment, Flocculants, Costs, Sludge treatment, Waste disposal, Organic compounds

D140
WATER TREATMENT BY OZONE,

Oda, K.

Seikatsu Eisei, Vol. 18, No. 6, p 168, 1974. 13 fig, 20 ref.

The use of ozone for water treatment is reviewed. The greatest advantage of ozone usage is that it does not give any reaction residue. Ozone is one of the strongest oxidizing agents, therefore it decomposes most compounds in a relatively short reaction time. Ozone can be used for decolorization, deodorization, sterilization, and decomposition of organic compounds as well as of inorganic compounds such as cyanides. The sterilization effect of ozone is 15 to 30 times stronger than that of chloride gas or hypochlorous acid. Most decomposition of unsaturated organic compounds by ozone is believed to proceed by ozonolysis followed by aldehyde formation and stable organic acid formation. Ozone is also useful in treating synthetic detergents such as alkyl benzene sulfonate for which biological treatment is very difficult. If ozone alone is used to treat water, a large amount of ozone consumption is needed and the process is less economical. Therefore, ozone treatment is recommended for use with other water treatment methods such as activated carbon and floatation techniques.

*Reviews, *Water treatment, *Ozone, Oxidation, Detergents, Organic compounds

Reaction time, Decolorization, Deodorization

D141
PILOT-PLANT STUDY OF DENITRIFICATION USING A SUBMERGED SAND FILTER AT RYE MEADS SEWAGE WORKS,

Collinson, B.

Water Pollution Control, Vol. 73, No. 6, p 685-692, 1974. 6 fig, 3 tab, 19 ref.

The reduction of nitrate from all sources in the River Lee at Chingford, Great Britain was investigated. Major sources of nitrate are sewage effluent, drainage and surface runoff from agricultural land. Of the possible methods of nitrate reduction, removal from effluent by the addition of a methanol carbon source and an anaerobic flooded sand filter was chosen. A pilot plant study at the Rye Meads Sewage Works used a submerged sand filter for sewage effluent treatment. Analysis of amm. N, chloride, phosphate, anionic synthetic detergents and nitrate were made using an Auto Analyzer. No significant differences in these between the work's effluent or the denitrified effluent were found. Suspended solids were reduced from 10 mg/liter to 5 mg/liter by passage through the sand filter. The COD values obtained were used as an indication of residual methanol. The methanol requirement is dependent upon nitrate concentration and continuous monitoring of nitrate would be necessary for a large scale plant. During seven months of testing the denitrification unit, it was shown that 96 percent of nitrate-N was removed from approximately 8000 liters per day of effluent with a contact period of seven minutes and 100 mg/liter of methanol added as a carbon source. The Rye Meads Works is amenable to denitrification using this process. Further plans include modification of the existing rapid-gravity sand filter, enabling up to 4540 cu m effluent per day to be denitrified.

*Filters, *Nitrates, *Sewage treatment, Effluents, Pilot plants, Runoff, Denitrification, Anaerobic treatment

Auto Analyzer, Rye Meads, Submerged sand filter

D142
WATER AND WASTEWATER DISINFECTION WITH OZONE: A CRITICAL REVIEW,

Kinman, R. N.

Cincinnati University,
Cincinnati, Ohio

CRC Critical Reviews in Environmental Control, p 141-152, January, 1975. 2 fig, 3 tab, 17 ref.

Technical literature on ozone disinfection, as an alternative to chlorine, is reviewed. General statements made include: ozone is a powerful bactericide and a powerful virucide in water or waste water; most waters and waste waters require a higher amount of ozone than chlorine on a mg/liter basis to accomplish the same disinfection; costs of disinfection with chlorine are lower than those of ozone. Also, ozone will probably not be widely used in the United States for municipal water disinfection unless the requirement in most states for residual disinfectants in the water after a specific contact time is changed, and unless cost is not considered as the major design consideration. Ozone disinfection may be implemented as a unit process in waste water reclamation plants for potable reuse application. Additional research on ozone as a disinfectant was suggested in the areas of: disinfection efficiency against organisms not yet studied; new contacting schemes to reduce capital costs and increase mass transfer; ozone measuring and monitoring systems; ozone production equipment; toxicity of ozonation products in disinfected water; physiological effects of low concentrations of ozone to man; and, BOD5, COD, and TOC relationships in ozone disinfection.

*Ozone, *Waste water treatment, *Water treatment, Chlorine, Costs, Biochemical oxygen demand, Municipal water, Potable water, Toxicity, Environmental effects, Design criteria, Treatment facilities, Monitoring, Reviews

D143
POPULATION DYNAMICS OF PROTOZOA IN WASTEWATER,

Varma, M. M., Finley, H. E., and Bennett, G. H.

Journal of the Water Pollution Control Federation, Vol. 47, No. 1, p 85-92, January, 1975. 5 fig, 2 tab, 20 ref.

A study was conducted to identify the dominant protozoa in the various parts of the waste water treatment processes of the Blue Plains Treatment Plant, Washington, D. C. Its second objective was to observe the dominant protozoa in the secondary effluent, within laboratory conditions simulating the plant, in order to determine whether or not the populations are influenced by environmental factors. Finally, the laboratory equipment simulating plant conditions was seeded with two peritrichs, Vorticella and Opercularia, and the common bacteria from the plant effluent; buffers and organic nutrients, sucrose and glutanic acid, were then added to determine whether these additives affected the growth of the protozoan populations. From the investigations, the relative importances of bacteria and protozoa in waste water treatment were examined. It was concluded that Vorticella, which is responsible for clarification, is dominant in secondary effluent. The death rate of Opercularia was not significantly affected by pH changes, while the Vorticella population was more sensitive to such changes. Also, when glutamic acid was added, the Opercularia population increases in number. These findings indicate that further tests should be made to determine the optimum protozoa:microorganism ratio at various substrate concentrations existing in a treatment plant. Tests are necessary to compare catalase activity with the ratio and also to determine whether the bacteria are dead or alive when they are digested by protozoa.

*Waste water treatment, *Bacteria, *Biological treatment, *Protozoa, Digestion, Laboratory investigations, Microorganisms, Clarification, Municipal wastes

Opercularia, Vorticella, Protozoa population dynamics, Blue Plains Treatment Plant, Washington, D. C.

D144
ACTIVATED CARBON ADSORPTION TECHNIQUE FOR THIRD STAGE SEWAGE WATER TREATMENT,

Kasakura, T.

Kankyo Sozo, Vol. 5, No. 1, p 72, January, 1975. 10 fig, 3 tab, 7 ref.

A pilot plant to test the activated carbon adsorption technique for the third stage treatment of sewage water was constructed and operates at Nagoya city. The third stage water treatment plant consists of precipitation, filtration, and adsorption processes. After second stage treatment by an activated sludge method, sewage water is mixed with aluminum sulfate to precipitate most of the phosphorous compounds. The precipitates are filtered out at the rate of 350 m/d before entering an adsorption tower filled with 320 kg of activated carbon, with average particle sizes of 0.90 mm. An average 72% of the total phosphorous in the second stage water was removed by the precipitation treatment, and 99% was further removed by the activated carbon treatment. The turbidity of the second stage water was improved an average 79% and 97% by aluminum sulfate precipitation and activated carbon treatments, respectively. The COD values in the precipitation and adsorption processes were 19.5 ppm and 1.8 ppm, respectively, and the corresponding TOD values were 38.9 ppm and 18.8 ppm. Several adsorption towers were installed in parallel and sewage water flowed through at the rate of 300 m/d. The life of activated carbon was between 800 to 1200 hr dependent on temperature which affected the efficiency of activated sludge treatment. The regeneration of deactivated carbon was seen to be achieved by heating at 800 C for 90 min.

*Waste water treatment, *Activated carbon, *Sewage treatment, Tertiary treatment, Pilot plants, Filtration, Precipitation (chemical), Adsorption, Turbidity, Phosphorous

Aluminum sulfate, Adsorption towers

D145
THE MECHANISM OF FLOCCULATION PROCESSES IN THE PRESENCE OF HUMIC SUBSTANCES,

Narkis, N., and Rebhun, M.

Journal of the American Water Works Association, Vol. 67, No. 2, p 101-108, February, 1975. 8 fig, 19 ref.

The mechanism of flocculation is detailed for a system with organic matter, particularly with clay suspensions interacting with humic and fulvic acids. A radioactively labelled cationic polyelectrolyte was used to facilitate this study. The phenomenon of flocculation is similar in any system where suspended solids interact with dissolved organic matter, such as in raw sewage or effluents from biological treatment plants. It was demonstrated that the salts of humic and fulvic acids, which are anionic polyelectrolytes, react chemically with the polycationic flocculant through carboxylate and phenolate groups and thus form colloidal-reaction-product flocculates which are removed by settling. In this case, a cationic polyelectrolyte was added to an organo-clay complex suspension dispersed in humate or fulvate solution. The polyelectrolyte was shown to react first with free humates and fulvates and only after the complete reaction with free organic acids did flocculation of the suspension occur. Because the presence of organic matter in solution or as a complex on the mineral clay particle surface inhibits the process of flocculation, large doses of the flocculant are necessary to produce reaction conditions favorable for complete reaction.

*Organic compounds, *Flocculation, *Waste water treatment, Polyelectrolytes, Cations, Anions, Suspended solids, Biological treatment, Fulvic acids, Humic acids, Colloids, Organic acids

Organo-clay complexes

D146
OZONE TREATMENT LICKS COLOR PROBLEM,

Water and Sewage Works, Vol. 122, No. 4, p 52-54, April, 1975. 3 fig.

The scheme of water supply treatment for the city of Manchester, England, and the Watchgate Treatment Works is described. The Works consists of five units--control, filter, washwater, contact tank, and ozone. Basic treatment involves rapid gravity filtration, super-chlorination and contact, pH correction, and chlorine residual control of the finished waters. A basic problem in the system was color reduction, associated with removal of particulate matter and sterilization. Water from Windermere and Haweswater, two of four sources, had color up to 7 degrees and 30 degrees Hazen respectively. Required characteristics of the treated water are pH 7.5 to 8.0, color less than 5 degrees Hazen, and turbidity less than 2 ppm. To remove color from the Haweswater water, pre-treatment by filtration and chlorination is followed by ozonization in three separate streams. The use of ozone is particularly suited to the limited head available throughout the plant. Ozone may also be used to sterilize Haweswater water if chlorine is not available, and to control tastes and odors when required. A plan of the Watchgate Treatment Works is detailed, whereby the ozone unit may be utilized or by-passed. The layout includes administrative offices, laboratories, a control room, an equipment room, and chemical storage facilities; the site provides for alternative treatment methods.

*Waste water treatment, *Water supply, *Ozone, *Chlorination, *Treatment facilities, Color, Odors, Filtration

Color removal, Watchgate Treatment Works, Ozonization

D147
ON-SITE HYPOCHLORITE GENERATION,

Kuhn, A.

Processing, Vol. 21, No. 3, p 6-7, 1975. 4 fig.

It has been shown that on-site generated sodium hypochlorite has several uses. The application for which this process has the greatest potential is in the treatment of municipal sewage. A successful demonstration of the process at Guernsey, Great Britain, involved pure seawater electrolysis followed by its passage to a separate stirred reactor tank where it was contacted with sewage. In the United States, several installations using on-site hypochlorite generation are in operation. In Clark County, Nevada, only the supernatant liquid from the primary digester, rather than a full effluent stream, was electrolytically treated. Liquor was passed through the actual electrolysis cell using electrodes of PbO_2; benefits were attributed to direct oxidation of dissolved or suspended matter at the electrode surface. Vigorous evolution of gases achieved a flotational effect. The froth that formed carried with it a high proportion of solids, leaving the liquor lower in COD. Modern commercially available hypochlorite cells are described; all were of the force-flow, narrow gap design. The treatment processes detailed are also useful in oxidizing and disinfecting within the chemical industry, in heat exchanger fouling control, in deodorizing for tobacco plants, and in sterilizing of food processing equipment.

*Waste water treatment, *Sodium compounds, *Sewage treatment, *Municipal wastes, Electrolysis, Chemical industry, Industrial wastes, Equipment, Oxidation, Odors, Chemical oxygen demand

On-site generation, Sodium hypochlorite, Great Britain, Hypochlorite cells

D148
FIRST STAGE OF THE WORLD'S LARGEST PURE OXYGEN SEWAGE PLANT TO UNDERGO TEST,

Engineering News-Record, Vol. 194, No. 2, p 16-17, January 9, 1975.

The Detroit Metro Water Department, of Detroit, Michigan, has built a 300-mgd pure oxygen treatment system for municipal wastes. A 600-mgd capacity additional facility is under construction for 1977, which will make the system the world's largest pure oxygen plant. The system was chosen on the basis of space considerations, successes with pure oxygen aeration elsewhere, and tests with a 100,000 gpd pilot plant. The new system has been tested to be capable of reducing BOD and suspended solids in effluent to 20 ppm, which is below the design goal of 30 ppm. Two identical aeration tanks were built five years ago at the projects inception, one with oxygen and one with air equipment. In July, a comparison will be made, and it is hoped that the air system will be converted to oxygen. The new installation needs only 48% of the air system's power because the partial pressure of oxygen in air is 160 mm of mercury, whereas the partial pressure of pure oxygen is 760 mm. Thus, a pure oxygen system has almost five times the internal driving force of an air system, requiring less pumps, condensers, and mixers. The system, including the Detroit plant's high-capacity final clarifiers should cut operating and capital costs by $21 per million gallon each year. Because the Detroit plant is landlocked, the sewage plant has installed deep tanks to conserve space. Other design considerations include air sampling for automatic shutdown should volatile hydrocarbons in sewage reach 20% of their explosive limit. Further tests will demonstrate the system's operation in cold weather.

*Oxygen, *Aeration, *Sewage treatment, Pilot plants, Municipal wastes, Treatment facilities

*Detroit (Mich.), Oxygen, Hydrocarbons

D149
SOME STUDIES ON NITRIFICATION IN THE ACTIVATED SLUDGE PROCESS,

Hall, I. R.

Water Pollution Control Department,
Sheffield CBC,
Great Britain

Water Pollution Control, Vol. 73, No. 45, p 538-547, 1974. 4 fig, 2 tab, 22 ref.

Nitrification in the activated sludge plant for removing ammonia at Sheffield's Blackburn Meadows sewage works was investigated. This sewage contains about 25 percent industrial waste water, including metal finishing wastes. It was thought that nitrification would be the most economical method of removing ammonia. Results of experimental testing showed that sewage from this plant can be consistently nitrified using the activated sludge method. The rates of growth of Nitrosomonas in activated sludges grown on an industrial and domestic sewage, when ammonia was not rate-limiting, were higher than those reported elsewhere for low temperature domestic sewage. The pH value for nitrification was always above 6.3 and nitrifying activity of activated sludges was independent of pH value in the range of 7 to 9. Discussed also was a simplified method to predict whether nitrification will occur, from consideration of either sludge loading or sludge wastage. In addition, it was suggested that new discharges to sewers be screened for potential toxic hazards.

*Nitrification, *Sewage treatment, Ammonia, Industrial wastes, Toxicity, Activated sludge, Hydrogen ion concentration

Ammonia removal, Nitrosomonas

D150
PRESERVING ACTIVATED SLUDGE,

Nissen, J. A., and Vesilind, P. A.

Wiggins-Rimer and Associates, Durham, North Carolina

Water and Sewage Works, Vol. 121, No. 8, p 48-52, August, 1974. 7 fig, 5 ref.

Many problems result when the sludge from pilot or bench-scale experiments is transported to consultants, equipment manufacturers, or commercial laboratories for analysis. A cheap, readily available method of preserving waste water sludges is needed that is capable of stopping all biological action, without changing the physical characteristics of aerobic or anaerobic sludge. The preservative agent should possess the following attributes: be able to kill the types of organisms found in biological sludge before biological action can alter the physical characteristics of the sludge; the physical structure of the cells killed should not be changed by the action of the preservative; the required dosage should not be large enough to significantly dilute the sample; the preservative should not be hazardous to humans; and, the preservative should be economical and readily available. As a result of the experiments performed, formaldehyde is considered an acceptable preservative for activated and digested sludge. Dosages sufficient to effectively kill activated sludge organisms are in the range of 0.5-1.0 percent commercial grade formaldehyde (by volume). Activated sludge which undergoes anaerobiasis and becomes anaerobic demonstrates much better settling characteristics and a lower viscosity than the fresh or preserved sludge. Digested sludge organisms were found to be sensitive to very small dosages of formaldehyde. Small dosages of formaldehyde do not significantly change the physical nature of digested sludge or interfere with the action of chemical conditioners.

*Activated sludge, *Preservation, *Analysis, Analytical techniques, Testing, Biodegradation, Sludge digestion, Microbial degradation

*Formaldehyde

D151
OPTIMUM VALUES FOR OPERATIONAL VARIABLES IN TURBIDITY REMOVAL,

Al-Layla, M. A., and Middlebrooks, E. J.

Mosul University, Iraq

Water and Sewage Works, Vol. 121, No. 8, p 66-69, August, 1974. 9 fig, 3 tab, 8 ref.

A study was designed to define the effect of the main variables that can influence the efficiency of present flocculation basins in water treatment plants, thereby contributing to improving the design of flocculation basins. Variables were paddle speed, time, and alum dosage. The other objectives were to determine the interactions between time of flocculation and alum dosage, flocculation time and paddle speed, and paddle speed and alum dosage, and to formulate the relationships between turbidity removal and alum dosage, flocculation time, and paddle speed. Methods included analysis of variance, linear, logarithmic, and multivariable mathematical models. It was concluded that the most significant independent variable was paddle speed followed by flocculation time and alum dosage; optimum alum dosage was 25 mg/liter for the study conditions; optimum paddle speed ranged between 40 and 50 rpm; and optimum flocculation time was about 30 minutes. Certain equipment and methods were shown to be important in removal of turbidity from water treatment plants. These were variable speed flocculator paddles, multiple flocculation basins that can be used in series or parallel operation,and the use of jar tests to determine the optimum alum dosage continuously during the operation of water treatment plants.

*Flocculation, *Water treatment, *Turbidity, *Alum, *Mathematical models, Operations, Treatment facilities

Alum dosage, Water treatment plants, Turbidity removal

D152
DISINFECTING WASTEWATER WITH CHLORINATION/DECHLORINATION PART 2,

White, G. C.

Consulting Engineer, San Francisco, California

Water and Sewage Works, Vol. 121, No. 9, p 93-95, September, 1974. 1 fig.

The three major factors that account for the difference in the sensitivity between potable water and waste water to the disinfection process by chlorine are the magnitude of coliform concentration prior to chlorination, the ammonia nitrogen content, and the relatively high organic nitrogen content in waste water effluents. The most efficient chlorination disinfection systems studied had four attributes in common: very good initial mixing; sufficient contact time (at least 30 min. at peak flow) in an outfall conduit or a well designed basin; a good automatic chlorine residual control system; and, competent operating personnel. Mixing should ideally be completed in a fraction of a second. In actual operation, mixing completed within one to three seconds is considered excellent. A tubular type of reactor or a closed conduit are both good mixing devices. A chlorine contact chamber should provide sufficient residence time for the chlorine to reduce the harmful and objectionable microorganisms to acceptable levels. Closed conduits are the best contact chambers followed by long narrow outfall channels as the second best type. There are two types of chlorine residual control systems: straight residual control where the analyzer controls both the change in flow rate and chlorine demand of the waste water; and, compound loop control where the control apparatus receives signals from a flow measuring device and from a residual analyzer. The compound loop system is recommended because of its ability to cope with sudden changes in flow.

*Chlorination, *Disinfection, *Equipment, *Waste water treatment, *Potable water, Control, Water purification, Water treatment, Sewage treatment, Water quality control

D153
DISINFECTING WASTEWATER WITH CHLORINATION/DECHLORINATION PART 1,

White, G. C.

Water and Sewage Works, Vol. 121, No. 8, p 70-71, August, 1974. 1 fig.

The disinfection of waste water is as important in waste water treatment as BOD, suspended solids, and grease removal. The chemistry of waste water chlorination is described. When a chlorine solution from a conventional gas chlorinator enters the waste water stream the reaction that takes precedence over all others is the reaction between free chlorine and ammonia nitrogen to form chloramine and water. This reaction is 99% complete in a fraction of a second at 60-65 F and pH 7.5. The mechanism of disinfection is generally accepted to be penetration through the cell wall of the microorganism by the chlorine compound and a chemical reaction between the compound and the vital parts of the microorganism so that reproduction is ended. When potable water is chlorinated that contains only an excess of ammonia nitrogen, the resulting compounds are almost all monochloramines. However, if organic nitrogen is present in amounts greater than 0.15 mg/liter, dichloramine begins to form. This compound or similar compounds have a poisoning effect on chlorine residuals that are only a few minutes old and for this reason back-mixing or short circuiting in a chlorine contact chamber should be avoided. The mathematics of the most probable number (MPN) of coliform concentration from a quantitative viewpoint is presented. The following equation was developed from a pilot plant system that had excellent mixing: y=y sub o (1 + 0.23 ct) where y=MPN in chlorinated waste water at end of time t; y sub o=MPN in effluent prior to chlorination; c=total chlorine residual in mg/liter; and, t=contact time in minutes. This mathematical model illustrates the importance of waste water quality on the attainment of a low coliform concentration.

*Waste water treatment, *Chlorination, *Coliforms, *Disinfection, Chemical reactions, Mathematical models, Biochemical oxygen demand, Suspended solids, Chemistry, Potable water, Water treatment, Sewage treatment

D154
NITROGEN REMOVAL BY CATALYST-AIDED BREAKPOINT CHLORINATION,

Stasiuk, W. N., Hetling, L. J., and Shuster, W. W.

Environmental Quality Unit, New York State Department of Environmental Conservation, Albany, New York

Journal of the Water Pollution Control Federation, Vol. 46, No. 8, p 1974-1983, 1974. 7 fig, 2 tab, 10 ref.

Under certain conditions, the removal or conversion of nitrogenous species in waste waters is necessary. Ammonia must be removed to a form with no direct oxygen demand when ammonia nitrogen exerts a large drain on the oxygen resources of the receiving waters. When the nutrient that limits algae growth is nitrogen, removal is needed to eliminate nuisance algal blooms. Methods developed for the conversion, reduction, or removal of ammonia nitrogen in waste waters include biological nitrification-denitrification, selective ion exchange, air stripping at elevated pH, and breakpoint chlorination. A technique for reducing nitrogenous oxygen demand submitted to the New York State Department of Environmental Conservation utilized adsorption of chloramines on activated carbon. Chloramines are formed in chlorinated waters containing ammonia and hypochlorous acid. Previous chloramine formation studies were handicapped by the occurrence of decomposition reactions at low pH, as well as Cl:N ratios greater than 5. These consisted of the loss of oxidizing chlorine and ammonia nitrogen, and are called breakpoint chlorination reactions. An advantage would be realized if monochloramine were adsorbed on activated carbon. The theoretical Cl:N ratio for 100 per cent removal of ammonia would decrease from 76:1 for breakpoint to approximately 5:1 for the formation of monochloramine to be adsorbed on the carbon.

*Nitrogen removal, *Ammonia, *Algae, *Chlorination, *Waste water treatment, *Water pollution, Nitrification-denitrification, Ion exchange, Oxidation, Activated carbon, Nitrogen compounds, Nutrient removal, Adsorption

D155
DEWATERS SLUDGE,

Water and Wastes Engineering, Vol. 11, No. 8, p 45, August, 1974. 1 fig.

A centrifuge called the Sludg-a-Tron is being utilized in pollution control and processing services for dewatering and concentrating a wide range of industrial, municipal, institutional and commercial sludge wastes. The centrifuge is able to concentrate sludges from one percent, solids up to 35 percent solids by weight and higher, treating aerobically digested sludges, biological sludges, waste activated sludges, water treatment alum sludges, and other industrial wastes. The Sludg-a-Tron is expected to be broadly utilized in waste treatment facilities on two-stage dewatering systems. A high solids capture rate, with efficiencies ranging up to 99 percent, is achievable without the use of polyelectrolytes or flocculants. The centrifuge can achieve a uniformity of cake, and a high degree of cake compaction, without regard to feed rate or composition. Some advantages listed are maximum installation space, low operating speed, minimum power requirements, design simplicity, choice of driving arrangements, and a large range of options and accessories.

*Sludge, *Dewatering, *Water pollution control, *Centrifugation, Industrial wastes, Municipal wastes, Commercial wastes, Waste water treatment, Alum, Activated sludge, Equipment

*Sludg-a-Tron

D156
A SOLUTION TO PUMP STOPPAGES,

Nelson, S.

Water and Sewage Works, Vol. 121, No. 9, p 106, September, 1974.

One problem in sludge digestion and treatment is the stoppage of waste pumps. This is caused by large articles such as cans, bottles, rags, and sticks which get pumped along with primary sludge to an aerobic digester, then to drying beds where they cause the pumps to become inoperative. The Irvine Ranch Water District has solved this problem by the use of a new unit called the Disposable Waste Systems Comminutor/Macerator, installed in the influent channel. This six inch model processes solid material prior to any pump action. The unit can run unattended for several months. The Irvine Ranch Water treatment plant has been using this machine for eight months continuously. Primary sludge and skimming pumps that feed the Comminutor/Macerator share a common discharge line; flow can be to both pumps at once or to either individually. Three new Communitor/Macerators, 40 inch models, will be installed in the system in the near future.

*Pumps, *Sludge digestion, Solids, Flow, Sewage treatment, Waste water treatment, Treatment facilities

*Comminutor/Macerator, Irvine Ranch Water District

D157
WASTEWATER TREATMENT USING ALGAE AND ARTEMIA,

Jacobson, A. R.

Illinois State University, Normal, Illinois,
College of Applied Science and Technology

Public Works, Vol. 105, No. 10, p 114, October, 1974.

A new system of controlled eutrophication for either waste water or high organic wastes was investigated. Laboratory studies used Chlorella and Tetraselmis algae in conjunction with Artemia salina (brine shrimp) to provide controlled purification of raw and treated waste. Artemia could be adapted to live in secondary treated waste with no aeration, raw waste with aeration, or raw waste in which Tetraselmis or Chlorella had bloomed. The optimal treatment for raw waste was: algal growth with artificial light; addition of Artemia; decantation, followed by additional algal growth; and, final decantation. Sanitary chemical methodology was used to determine parameters of total suspended solids, biochemical oxygen demand, turbidity, odor, orthophosphate, nitrate, nitrite, and ammonia. All of these parameters were reduced by the process to levels associated with at least conventional secondary treatment and possibly tertiary treatment. Implications of mariculture were also discussed.

*Eutrophication, *Organic wastes, *Algae, *Artemia, Waste water treatment, Sewage treatment, Aeration, Tertiary treatment

Raw wastes, Mariculture

D158
TEMPERATURE EFFECTS ON MICROBIAL GROWTH IN CSTR'S,

Muck, R. E., and Grady, C. P. L.

Cornell University, Ithaca, New York, Department of
Agricultural Engineering

Journal of the Environmental Engineering Division, Vol. 100, No. EE5, p 1147-1163, October, 1974. 6 fig, 5 tab, 33 ref.

In order to apply sound engineering judgment to decisions concerning biochemical processes, including the removal of soluble organics in waste water treatment, it is necessary to quantify the effects of various parameters acting upon them. The effects of temperature upon the four parameters which describe the continuous growth of a natural microbial population in a Continuous Stirred Tank Reactors (CSTR'S) are discussed. Results of the laboratory studies conducted showed that the maximum specific growth rate constant and the bacterial decay rate constant increased with increases in temperature according to the Arrhenius equation over the temperature range of 10 C-30 C. The ratio of the temperature characteristics for decay to that for growth was 1.11. The true growth yield was observed to increase as the temperature was increased from 10 C to 20 C, but to decrease with further rises in temperature. The saturation constant decreased slightly when the temperature rose from 10 C to 20 C, and then rose greatly when the temperature was increased to 30 C. The results of the study agree with the findings of other workers as reported in the literature. It seems that the physical characteristics of the experimental system may have some effects on the effects of temperature on the saturation constant. The system-descriptive parameters analyzed are independent of the operational conditions imposed on waste water treatment systems. By utilizing the equations presented, design engineers can choose the proper treatment conditions for an effluent without having to rely on generalizations about the effects of temperature on plant performance.

*Waste water treatment, *Temperature, *Biological treatment, *Engineering, Microbial degradation, Microorganisms, Laboratory tests, Nutrient removal, Bacteria

D159
PROBLEMS OF LIQUID WASTE DISPOSAL,

Could, B. W.

The Institution of Engineers, Australia, Civil Engineering Transactions, Vol. CE16, No. 1, p 71-74, 1974. 10 ref.

A review and discussion of the current problems in liquid waste pollution are given. An increasing need is noted in Australia for controlling effluent discharges, due to industrial expansion as well as growth and density of human populations. The types of pollution described include: oxygen consuming capacity or BOD, which results in fish kills by suffocation; suspended solids, which produce turbidity and reduce penetration of light; pathogenic organisms from enteric human wastes which may spread infections; nutrients which cause eutrophication and upset the ecological balance in waters; toxic materials, especially metals; irritants such as detergents, which are harmful or fatal to fish; dissolved salts, from water used for domestic purposes or irrigation; and carcinogens, mutagens, and teratogens, which may have long term effects. In addition, the aesthetic value of a stream may be destroyed by foam or grease, and discoloration from dyes or floating rubber can lead to undesired odors and tastes. Effluent discharges from both domestic sewage and various industrial wastes are discussed. Solutions to the various problems of liquid wastes in Australia may be found in engineering ability to apply technology to these environmental problems, in political concern and public pressure, and in availability of funds for pollution control facilities.

*Liquid wastes, *Water quality control, *Australia, Effluents, Water pollution control, Biochemical oxygen demand, Turbidity, Eutrophication, Fish kills, Toxicity, Reviews

D160
A PLANNING OF CATCHMENT SEWERAGE FOR OYODO RIVER,

Ishiguro, M., and Watanabe, Y.

Myazaki Daigaku Kogakuru Kenkyu Hokoku, No. 20, p 35-45, August, 1974. 5 fig, 12 tab, 20 ref.

A plan of catchment sewerage for protecting water quality of the Oyodo River in Japan is discussed. Present and future water quality were analyzed according to observed data. The river catchment area was divided into three blocks and the water pollution loads in each block were estimated. Within each area, construction-maintenance costs and treatment efficiencies of various sewer transport-treatment systems were compared. It was concluded that construction of high degree treatment plants with an activated sludge process for 95% BOD removal should be implemented in all three blocks. However, a treatment plant of 95% BOD removal is very difficult using present techniques. Thus, it was advised to use other treatment processes simultaneously. These included irrigation treatment, oxidation ponding, lagooning, and a rotating biological contactor process, in addition to a plant of 88% BOD removal with an activated sludge process.

*Sewerage, *Planning, *Waste water treatment, *Water quality control, Construction costs, Rivers, Water pollution, Treatment facilities, Biochemical oxygen demand, Waste treatment, Activated sludge

Oyodo River (Japan), Catchments

D161
ADVANCED WASTEWATER TREATMENT,

Shimodo, M., and Okada, Y.

Onoda Kenkyu Hokoku, No. 26, p 92-98, 1974. 11 fig, 9 ref.

Advanced waste water treatment technology is utilized to remove pollutants which are not adequately removed by conventional secondary treatment processes. Such pollutants include soluble inorganic compounds (phosphorus, nitrogen) which may support algal growth in receiving water. Lime precipitation is the most useful technology for removal of phosphorus compounds from waste water. The chemical reactions of lime precipitation involve the condensed phosphate being readily hydrolyzed in the presence of Ca^{2+} and OH^-. Calcium hydroxide then reacts with orthophosphate to precipitate calcium hydroxyapatite. As pH increases above 10.0, the precipitation of calcium hydroxyapatite increases, so that phosphate removal is improved with increasing pH. Also, calcium-hydroxide reacts with the bicarbonate alkalinity of waste water to form calcium carbonate and calcium hydroxide is regenerated.

*Waste water treatment, Tertiary treatment, Nitrogen, Phosphorus, Lime, Precipitation (chemical), Calcium carbonate, Calcium hydroxide, Inorganic compounds

Advanced waste water treatment

D162
SLURRY DELIQUORING BY EXPRESSION,

Shirato, M., Murase, T., and Aragaki, T.

Nagoya University,
Chikusa, Nagoya, Japan,
Department of Chemical Engineering

Dechema Monographien, Vol. 74, No. 1432/1451, p 9-39, 1974. 27 fig.

The theoretical developments and subsequent experiments to verify equations concerning the expression process, defined as the separation of a liquid from a solid-liquid system by compression, are discussed. The expression method of deliquoring is widely used in both chemical process industries and in sewage sludge treatments. Its mechanisms consist of two steps of flow phenomena, which may be analysed first by filtration theory and second by consolidation theory. Expression operations are seen to be classified into three types: constant pressure; constant rate; and variable pressure-variable rate operations; according to the time-pressure and flow rate relations. Basic laws govern the flow of fluids through porous media, and conventional definitions of filtration and consolidation characteristics aid in developing basic consolidation equations, as well as new definitions of filtration ratio, consolidation ratio, and modified consolidation coefficient. Good agreement between theories and experiments by using compression-permeability cell data was demonstrated.

*Separation techniques, *Sewage treatment, *Waste water treatment, Sewage sludge, Equations, Filtration

Solid-liquid systems, Compression, Deliquoring, Expression

D163
CHLROINE-CONTAINING ORGANIC CONSTITUENTS IN CHLORINATED EFFLUENTS,

Jolley, R. L.

Oak Ridge National Laboratory, Oak Ridge, Tennessee,
Experimental Engineering Section, Chemical Technology Division

Journal of the Water Pollution Control Federation, Vol. 47, No. 3, p 601-618, March, 1975. 3 fig, 7 tab, 29 ref.

An examination was made of the chlorine-containing compounds present in the chlorinated primary and secondary effluents from two domestic waste water treatment plants. A 36Cl tracer, high resolution chromatographic method was used in the examination. Conclusions reached as a result of the study as are follows: stable chlorine-containing organic constituents were present after effluents had been chlorinated to a 1 to 2 mg/liter chlorine residual; anion-exchange chromatographic elution positions were established for these constituents; the chlorination yield was about one percent for a typical chlorinated secondary effluent; the chlorination yield was approximately constant with respect to chlorine dosage, but increased with increasing reaction time; the chlorination yield was about equal for both primary and secondary effluents; the major portion of the available chlorine in the chlorination of effluent was consumed in oxidation reactions; and, essentially equivalent results were obtained regardless of whether the effluent was chlorinated with chlorine gas or with hypochlorite solution.

*Waste water treatment, *Chlorine, Analytical techniques, Chromatography, Municipal wastes, Effluents, Chlorination, Organic compounds

Secondary treatment, Organic constituents

D164
HUNTINGDON RESEARCH CENTRE PASVEER OXIDATION PLANT--SIX YEARS ON,

Spring, B. J., and Briscoe, E. R. E.

Huntingdon Research Centre, Department of Building and Maintenance

Public Health Engineer, Vol. 14, p 35-39, March, 1975. 4 tab.

The operation of the waste water treatment plant (Pasveer Oxidation Plant) at the Huntingdon Research Centre is described for the years following its installment in 1966. The capacity of the system to absorb heavy temporary overloading was established but the increased loading and greater sludge production increased the time required to clear the draw-off system and also increased the time required to draw-off the total volume, thus reducing the time available for oxygenation. The reduction of oxygenation time made additional oxidation capacity necessary. To meet the oxygen input requirement, a Flygt Pump, type CG 3605, was installed in May, 1971. In October, 1972, a new oxidation channel began operation. Several charts are included which show the average daily flow based on a 7-day week, the average daily flow based on a 5-day week, and the peak daily flow for every month in the years 1967 through 1973. The results of studies performed throughout 1968-1971 are presented in chart form. These include: BOD loading in terms of kg/d and percent of design limit; BOD in the raw waste, channel discharge, and final effluent; suspended solids in the raw waste, channel discharge, and BOD reduction overall in the channel discharge and final effluent. It is apparent from the records of the plant that there is no "typical day" and that the volumes and characteristics of the waste vary considerably and do not follow any consistent pattern. The plant has had no odor problem of any kind and a recreational area is being planned for its surrounding land.

*Waste water treatment, *Facilities, *Design criteria, *Activated sludge, *Oxygenation, Biochemical oxygen demand, Oxygen requirements, Oxidation lagoons

Oxidation channels

D165
AERATION DEVICES: BASIC THEORY,

Marais, G. v. R.

Cape Town University, Water Resources and
Public Health Engineering Department

Water Pollution Control, Vol. 74, No. 2, p 172-173, 1975.

Aeration in waste water treatment is the process by which oxygen is supplied to the liquor so that the organisms present are able to oxidize the organic content of the waste water. The three stages of transfer of oxygen from the gaseous to liquid phase are: transfer of the oxygen molecules from the air to the liquid interface; passage of the oxygen through a liquid film of about three molecules thick by molecular diffusion; and, dispersion of the oxygen into the body of liquid by further diffusion and convection. The two basic types of aeration devices, diffused-air bubble aerators and mechanical aerators, both utilize the first stage of oxygen transfer. The diffused-air principle introduces small air bubbles through diffusers; oxygen transfer from the interface to the body of liquid is governed principally by the process of molecular diffusion and therefore is greatly affected by surface impurities in the liquid. In mechanical aeration, the shearing action of the impellers creates new interfaces; mass transfer is governed by surface renewal and only slightly affected by diffusion transportation. Manufacturers of aeration equipment usually give a figure for the oxygen transfer rate, the mass of oxygen that the aeration device can introduce into a body of water per unit of time-per unit of power absorbed at the aerator shaft. Equations are presented which enable one to modify the manufacturer's figure for oxygen transfer rate to allow for non-standard conditions during operation.

*Waste water treatment, *Aeration, *Equipment, Air entrainment, Bubbles, Aerobic conditions, Oxygen, Mixing, Dissolved oxygen

*Diffused-air bubble aerators, *Mechanical aerators

D166
ADJUDICATING TENDERS FOR AERATION DEVICES: BEST VALUE AND RELIABILITY,

Halliday, J.

Water Pollution Control, Vol. 74, No. 2, p 184-185, 1975.

In deciding which aeration device to choose one must consider more than just the capital cost. One method for doing this is to calculate the annual interest and redemption on the capital and add this to a calculated cost of power required. For a conventional aeration plant the annual power cost may equal the annual interest and redemption on the aeration equipment, while for an extended aeration plant the cost of power may be twice that of interest and redemption. The efficiencies of all the components of an aeration device must be examined in relation to their particular mode of operation. Efficiencies of all the components of an aeration device tend to decrease with reduced load. This reduction in efficiency must be considered where water levels vary considerably or if there is to be oxygen control by means of two-speed motors or varying the depth of aerator immersion. In terms of reliability attention should be given to the drive for the aerator, the gearboxes, bearing life, to methods which prevent the total loss of oil from the gearbox in the event of the failure of the oil seal, and which prevent moisture from getting in the gearbox. Ensuring reliability in the plant begins in the specifications. Reliability costs money and is dependent upon good basic mechanical design. The purchaser should set his minimum standards in the specifications and then perhaps place weight on the additional features which may be offered by various aeration devices.

*Aeration, *Equipment, *Waste water treatment, Costs, Economics

*Aeration devices

D167
SETTLEMENT AND SLUDGE RETURN IN ACTIVATED-SLUDGE TYPE PACKAGE PLANTS,

Vosloo, P. B. B.

Water Pollution Control, Vol. 74, No. 2, p 197-198, 1975. 2 ref.

The sludge in most activated sludge package plants occasionally tends to be light and bulky. This is frequently due to over aeration. To control this, the oxygen input should be arranged so that at peak flow the DO drops to below one mg/liter, while at low flows it rises to 3 or 4 mg/liter. Because of the tendency of package plants to produce a light, flocculent sludge, it is recommended that their sedimentation sections provide for a lower rise rate than that which is normally acceptable for larger plants. It is better to by-pass a portion of the incoming flow when a period of abnormally high flow coincides with a period of abnormally light sludge, rather than to pass everything through the plant and risk losing a large proportion of the activated sludge. Many packaged plants do not have mechanical means for returning sludge but rely instead on the slight difference in density between sludge in the lower portions of the settling zone and the mixed liquor in the aeration zone to make the sludge flow back into the aeration zone by gravity. This type of system has been found unsatisfactory. The best type of package plant has a pump for the return of the sludge. Sludge return ratios in excess of 1:1 are unnecessary unless the sludge level in the settling zone rises to near the overflow level in which case the ratio may be increased to 1.5:1 or even 2:1.

*Activated sludge, *Waste water treatment, *Facilities, Aeration, Sludge, Dissolved oxygen, Sludge treatment

*Packaged plants, Sludge return

D168
INVESTIGATIONS ON THE LONG TERM BIOCHEMICAL OXIDATION OF SEWAGE,

Stones, T.

Salford Group Manager, Middle Mersey Effluent Treatment Unit, North West Water Authority

Water Pollution Control, Vol. 74, No. 2, p 231-233, 1975. 2 fig, 1 tab, 16 ref.

The biochemical oxidation of sewage occurs in two broadly distinct stages, the first of which is attributed to the oxidation of the carbonaceous compounds present in the sewage, and the second to the oxidation of the nitrogenous matter present. However, the dichromate value of sewage which closely approximates the total carbonaceous oxygen demand greatly exceeds the first-stage BOD thus indicating that only part of the carbonaceous material is oxidized in the first step. Experiments performed determined that the remainder is inert to biochemical oxidation and is not oxidized along with the nitrogenous matter during the second stage. It was found that a second stage of biochemical oxidation of sewage is due to the fact that an induction period of about eighteen days (for the proliferation of the nitrifying organisms initially present) is necessary before nitrification can begin. This lag period is coincidental with the time required for the carbonaceous oxidation rather than caused by an inhibiting effect of carbonaceous matter on the nitrifying organisms as had been previously thought to be the reason for the lag time.

*Sewage treatment, *Waste water treatment, *Biochemical oxygen demand, Biodegradation, Nitrification, Nitrogen compounds, Organic compounds, Oxidation

*Biochemical oxidation

D169
UNDERGROUND WASTEWATER TREATMENT PLANTS,

Isgard, E.

Vattenbyggnadsbyran Consulting Engineers,
Stockholm, Sweden,
Water and Environmental Division

Journal of the Water Pollution Control Federation, Vol 47, No. 4, p 684-687, April, 1975. 1 fig, 1 tab, 4 ref.

The underground construction of water reclamation plants is an established technique in Sweden. Problems encountered in design and operation of underground plants are discussed. While underground facilities were originally designed for civil defense, the present advantages of undergrounding are saving of space in urban areas, ease in expansion of facilities, environmental control, and protection against adverse weather. Specific cost problems are related to construction in various types of rock. Design criteria must consider expandability; for example, at Kappala, a transport tunnel was built between the existing and future plants. Proper heating and ventilation are necessary, particularly ventilation of hydrogen sulfide from pre-aeration. Measures must be designed for odor control and to prevent inudation and explosions. Careful tightening of excavation is also required to prevent drainage of soil above the excavations and settling of streets or buildings. Such design difficulties have been overcome at many underground facilities in the Stockholm area, providing favorable treatment results.

*Waste water treatment, *Construction costs, Water reuse, Facilities, Design criteria, Odor control

*Uudergrouud treatment plants, Ventilation, Sweden

D170
INNOVATIVE PROCESS TREATS WASTEWATER,

O'Sullivan, D. A.

Chemical and Engineering News, Vol. 53, No. 18, p 27-28, May, 1975. 1 fig.

A deep shaft process for waste water treatment may be considered as the most significant advance in sewage technology in the past 60 years. The advantages of this technique over conventional water treatment methods include: low capital and operating costs; more economical use of land; absence of offensive odor; and, lower production of sludge. The process involves continuous circulation of waste water throughout a vertical shaft. Aerobic bacteria feed on the entrained organic matter. A stream of air injected into the shaft provides both the driving force to maintain circulation and the oxygen necessary for aerobic biological treatment. The unit is a cylindrical steel or concrete shaft, with a diameter between 0.4 and 10.0 m, which extends into the ground to a depth of 100-300 m. The dimensions depend on the volume of effluent to be treated. A unit 135 m deep is capable of efficiently accepting and transferring one kg of oxygen/hr/cu m of effluent. The process results in an overall land saving of about 30%. The large activated sludge ponds and anaerobic digestion units are eliminated. Oxygen uptake efficiency can be 90% or greater in the new system compared with the 10% level achieved in present-day sewage treatment works. A pilot unit has been running continuously treating whole raw sewage from the sewage works at Billingham, Great Britain.

*Waste water treatment, *Sewage treatment, *Aeration, *Biological treatment, *Aerobic conditions, Facilities, Equipment, Pilot plants

*Deep shaft process

D171
ANAEROBIC ACIDOGENESIS OF WASTEWATER SLUDGE,

Ghosh, S., Conrad, J. R., and Klass, D. L.

Institute of Gas Technology, Chicago, Illinois,
Bioengineering Research

Journal of the Water Pollution Control Federation, Vol. 47, No. 1, p 30-45, January, 1975. 7 fig, 7 tab, 16 ref.

The anaerobic digestion process is popular in the waste treatment field because of the following reasons: its capability of stabilizing large volumes of dilute organic slurries at low cost; its low biomass production; the high kill rate of pathogenic organisms; its capability of producing solid residues suitable for use as soil conditioners; and, its ability to convert the organic carbon in the feeds to a product gas stream high in methane that can be substituted for natural gas. This study was designed to determine the feasibility of maintaining dominant cultures of acidogenic organisms with waste water sludge feeds by kinetic control, compile information on the biokinetic characteristics of acidogenic organisms; and, to develop guidelines and criteria for operating acid-phase digestion with waste water sludge feeds. A general discussion on the theory and operating principles of the two-phase digestion process is presented with special emphasis on the acidogenic phase of the total process. Results of the study showed that stable, steady-state operation of the two-phase process is possible with waste water sludge for extended time periods. The two-phase digestion process may be operated at one-half of the detention time of a high-rate digester and still exhibit higher rates of solids stabilization and methane production. The suggested reason for this high achievement is that phase separation allows the two groups of digester organisms to attain their full metabolic potential and thereby effect substantial improvement in overall digestion efficiency.

*Waste water treatment, *Methane, *Sewage treatment, *Anaerobic conditions, *Anaerobic digestion, Anaerobic bacteria, Digestion

Anaerobic acidogenesis

D172
TREATMENT METHODS OF GROUNDWATER CONTAINING A LARGE QUANTITY OF HUMIC ACID (AUFBEREITUNGSVERSUCHE AN EINEM STARK HUMINSTOFFBELASTETEN TIEFENGRUNDWASSER),

Harpe, T., and Eichelsdoerfer, D.

Vom Wasser, Vol. 42, p 207-220, 1974. 7 fig, 3 tab, 10 ref.

Treatment of water containing humic acids must consider special problems. Humic acids were identified in order to study their reactivity under different treatment methods. Experiments on deep groundwater with a high content of humic acids from Hamburg-Curslack, Germany, are reported. Colloidal brown humic acids were identified. The colloidal form was highly unstable against air oxygen. Thus, experiments were conducted to eliminate the organic matter by filtration on a pilot plant scale. In a closed system, raw water was filtered after aeration, using different filter materials. Without additional flocculants, humic acids can be removed to 3% of their original content.

*Humic acids, *Groundwater, *Waste water treatment, Water treatment, Organic compounds, Filtration, Pilot plants, Aeration

D173
$3-MILLION AND TWO-AND-A-HALF YEARS TO SOLVE CAMPBELL RIVER'S SEWAGE PROBLEMS,

Beardsley, G.

Water and Pollution Control, Vol. 113, No. 4, p 57-59, April, 1975.

The Campbell River District, British Columbia, has designed a secondary sewage treatment to fit the needs of its population of 11,000. The area had been subjected to intrusion of storm water into the sanitary system. A new collection system and treatment plant were planned and funded from various federal and provincial sources. The entire project was carried out between February 1972 and May 1974. A 14,000 foot long trunk pressure line was constructed so as to serve the area initially by gravity. An eighteen-inch diameter Sclairpipe was chosen for the pressure main. Four pumping stations were installed along the highway. Flygt pumps were used throughout the system. The installation of collector sewers was complicated by the problem of terrain, necessitating grading the trunks continuously because the shoreline is very close and seepage from the sea was a danger. The plant was designed and screened so as to be aesthetically compatible with its residential surroundings. Public relations efforts were also made and the reaction to the new system was favorable. The plant capacity is currently enough to serve a population of 15,000, with anticipated modular additions for a population of 30,000.

*Sewage treatment, *Waste water treatment, *Facilities, Storm runoff, Sewerage, Pipelines, Pumps, Interceptor sewers, Planning

Campbell River (British Columbia)

D174
OXIDATION OF ORGANIC COMPOUNDS IN WATER (OXIDATION ORGANISCHER VERBINDUNGEN IN WASSER),

Bannert, C., and Speiser, P.

Vom Wasser, Vol. 42, p 221-239, 1974. 3 fig, 12 tab, 14 ref.

The oxidative treatment of polluted water containing organic impurities is becoming increasingly important. The oxidative degradation of all organic material to carbon dioxide was studied by treating pure organic compounds (serving as models for common impurities) with hydrogen peroxide. The organic compounds were treated in aqueous solution for 15 minutes at 150, 225, and 300 C with hydrogen peroxide in the presence of catalysts. The optimum oxidation was found to occur in a 3 to 5 pH range and at 225 C. Temperature increases to 300 C as well as greater than stoichiometric additions of hydrogen peroxide were found to achieve no better oxidation effects. The concentration of the organic pollutants had no influence on the oxidation effect in the range investigated. The organic residuals were measured by gas chromatography as total organic carbon.

*Oxidation, *Waste treatment, *Organic compounds, Waste water treatment, Gas chromatography

*Hydrogen peroxide

D175
WATER TREATMENT FOR PUBLIC SUPPLY,

Hilson, M. A.

Chemistry and Industry, Vol. 1, p 21-25, January 4, 1975. 1 tab, 2 ref.

Various Acts of Parliament have put the burden on the supplier of supplying water that "is free from visible suspended matter, color, odor and taste, and from all objectionable bacteria indicative of the presence of disease producing organisms and contains no dissolved matter of mineral or organic origin which in quality or quantity would render it dangerous to health, and will not dissolve substances from the distribution system which are injurious to health." Water treatment to obtain such a water falls into 3 stages: bacteriological sterilization; chemical purification to remove objectionable matter; and, quality adjustment to ensure that the water does not pick up any harmful substances during distribution. The processes available to achieve the various stages are presented with emphasis on the processes used by the Fylde Water Board, Great Britain. Chlorine, chlorine dioxide, ozone, or ultraviolet radiation may be used for the sterilization of water. Chemical clarification consists of two stages: flocculation and separation of the solid material formed from the bulk of the water. The first step is achieved by the addition of a controlled dose of a coagulant. The floc formed during coagulation can be made tougher and denser by the addition of polymeric compounds. The removal of the solids from the water can be carried out either in a single stage process by direct filtration or by a two stage process of sedimentation followed by filtration. Water softening can be accomplished by precipitation or by ion exchange. Final quality adjustment is the adjustment of the pH value to a level at which the water will not corrode the pipelines or deposit calcium carbonate in the system.

*Water treatment, *Potable water, *Water quality control, Water distribution (applied), Flocculation, Coagulation, Filtration, Sedimentation

D176
ALGAE REMOVAL USING DISSOLVED AIR FLOTATION,

Bare, W. F. R., Jones, N. B., and Middlebrooks, E. J.

Ellsworth Engineering and Associates,
Idaho Falls, Idaho

Journal of the Water Pollution Control Federation, Vol. 47, No. 1, p 153-159, January, 1975. 18 fig, 3 tab, 26 ref.

The study described was conducted to evaluate the effectiveness and economy of dissolved air flotation as a method of removing algae from waste water stabilization pond effluents. The operating parameters studied included algae concentration, coagulant dosage, and percentage recycle. Some of the conclusions made, based on bench-scale and pilot plant tests, are as follows: direct pressurization did not provide good suspended solids removal in raw, naturally flocculated, or chemically flocculated algal samples; pressurized recycle greatly improved the removal efficiencies in naturally and chemically flocculated samples; 85 mg/liter of ferric sulfate were required to flocculate an algal suspension of about 100 mg/liter to obtain solids removal greater than 90% in the batch tests; 75 mg/liter of alum were required to flocculate an algal suspension of about 100 mg/liter to obtain solids removal greater than 90% in batch tests; 175 mg/liter of alum were needed to flocculate an algal suspension of about 125 mg/liter to obtain 90% solids removal in pilot plant tests; and, the difference in chemical requirements between pilot plant and bench-scale tests was thought to be caused by a higher concentration of algae in pilot plant tests, a major difference in the algal species being removed, and the dynamic nature of the pilot plant tests as compared with the static, ideal conditions of bench-scale tests. The total annual cost of operating a dissolved air flotation system was estimated to range from $39,000/year for a one mgd plant to $457,300/year for a 20 mgd plant.

*Waste water treatment, *Algae, Suspended solids, Flotation, Flocculation, Pilot plants, Laboratory tests

D177
PHYSICOCHEMICAL TREATMENT OF WASTEWATER-SEAWATER MIXTURE BY ELECTROLYSIS,

Poon, C. P. C., and Brueckner, T. G.

Rhode Island University, Kingston, Rhode Island,
Department of Civil and Environmental Engineering

Journal of the Water Pollution Control Federation, Vol. 47, No. 1, p 66-78, January, 1975. 6 fig, 4 tab, 23 ref.

A study was performed to determine the feasibility of a simple and reliable waste water treatment system using electrolysis of waste water and seawater. The process is intended for the removal of BOD, phosphorus and nitrogen, and also for disinfection. The electrolysis cell employed contains graphite anodes on the bottom of the cell with an iron cathode placed above them. Seawater is used as the anolyte and waste water as the catholyte. The electrolytic cell, operated as a batch unit, was shown to be capable of producing an effluent of higher quality than a secondary effluent. Both phosphates and nitrogen may be effectively removed to meet the most stringent effluent standard. However, some nitrogen content is inevitable in the final effluent. Therefore, the batch electrolysis process can be considered extremely effective when control of phosphates is absolutely required, but control of nitrogen is less critical. Polishing of the effluent from batch electrolysis treatment with activated carbon adsorption produce an essentially pollutant-free discharge. The batch operation necessitates the use of small treatment units. A bank of electrolytic cells can be used to handle moderate to high waste water flows. This may be higher in terms of the capital cost, but will add to the flexibility of the plant in terms of operation and expansion plans. The treatment requires no specialized operator training, uses no chemicals, produces a relatively small quantity of sludge, and is unaffected by low temperatures.

*Waste water treatment, *Electrolysis, *Nutrient removal, *Sea water, Activated carbon, Anodes, Cathodes, Electrochemistry, Phosphorus, Nitrogen

*Physico-chemical treatment

D178
DESIRABLE PROVISION IN CURRENT DESIGNS FOR FUTURE DEVELOPMENT IN RELATION TO RECLAMATION OF EFFLUENT,

Barnard, J. L.

National Institute for Water Research, Pretoria, South Africa

Water Pollution Control, Vol. 74, No. 2, p 177-180, 1975. 3 fig, 4 ref.

Modifications to the activated sludge process for the removal of nitrogen and phosphorus necessitate changes in the design and application of aeration equipment. The removal of phosphates from sewage by precipitation without chemical addition has been observed in plug-flow plants. In this case, fine bubble aeration in the last compartment and a minimum DO content of 3-4 mg/liter mixed liquor are recommended. When ferrous sulfate is used to precipitate phosphates (200 mg/liter ferrous sulfate), the oxygen requirements increase to 7.5 mg oxygen/liter of feed. The modification of the activated sludge process for the total removal of nitrogen involves recycling of nitrate-rich mixed liquor to a compartment at the head of the aeration basin. The first and third basins are not aerated but stirred to keep the solids in suspension. The DO in the second basin should be kept between one and 2 mg/liter. Therefore, the aerators in this basin should be of such a size and so located in the basin that they can be switched in or out according to the oxygen requirements. Whether to use surface aerators or bubble aerators depends upon several factors. Surface aerators are generally more economical than bubble aerators when only oxygen transfer efficiency is considered. The cooling effect of the various aerators needs to be considered when nitrification and denitrification are desired since reaction rates decline with decreasing temperatures. Automatic control of DO is recommended since this results in a power cost savings that can offset in two years the cost of the equipment for DO control.

*Waste water treatment, *Nutrient removal, *Design, Biological treatment, Denitrification, Sewage treatment, Aeration, Dissolved oxygen, Activated sludge

Phosphorus removal, Nitrogen removal

D179
ICI'S DEEP SHAFT 'HALVES SLUDGE VOLUME',

Appleton, B.

New Civil Engineer, April, 1975. 3 fig.

ICI's Agricultural Division has developed a new treatment process for raw sewage of industrial effluent. The effluent circulates around a 150 m deep shaft and emerges requiring only final settlement and sludge dewatering. The claims for the deep shaft process include: only 50% of the sludge volume generated by a conventional works; low capital cost; low operating cost; a highly efficient oxygen transfer system makes the process ideal for roughing treatment of high strength liquors; and, absence of odor. The process relies on a colony of bacteria in the circulating liquor to purify the effluent. The effluent circulates vertically in the shaft, completing about 20 circuits in the 2 hour retention time. The air used for biological oxidation also provides the driving force for liquid circulation. The process involves: feeding incoming sewage into a vertical carbon steel tube extending to the bottom of the shaft; recycled sludge from the subsequent sludge-separation stage is added to maintain the bacteria colony; air is injected into the inner tube to provide the necessary oxygen; spent air is vented to the atmosphere at the head of the shaft; and, a conventional overflow weir outlet carries the purified effluent to the sludge separation stage. Deep narrow shafts are preferred for weak liquors requiring high quality treatment, while roughing treatment of high strength industrial waste is most economically provided in shallower broader shafts. One hundred and fifty meters has been chosen as the optimum depth for domestic sewage treatment, the shaft diameter being fixed by the design retention time of 2 hours.

*Waste water treatment, *Sewage treatment, Biological treatment, Facilities, Equipment, Industrial wastes, Sludge

*Deep shaft process, Sludge production volume

D180
MEMBRANE DESALTING GETS BIG PUSH,

Mattson, M. E.

Office of Water Research and Technology,
U. S. Department of the Interior,
Membrane Processes Division

Water and Wastes Engineering, Vol. 12, No. 4, p 35, 36, 38, 40, 42, April, 1975. 7 fig.

Two large brackish water membrane desalting plants are near completion. One, in Santa Ana, California, has planned a multi-phase program for its 75 mgd facility to test reverse osmosis (RO), electrodialysis (ED), and ion exchange. On the lower Colorado River, an even larger desalting plant, of 100 mgd, is planned, with a test facility at Yuma, Arizona to evaluate pre-treatment and to compare reverse osmosis, and electrodialysis, and the use of a combination of these two processes. Design characteristics, advantages, problems, and costs of RO and ED are detailed. While both methods have only recently been applied to large municipal water systems (ED in 1962, RO in 1971), treatment plant personnel have been satisfied with each. Economic comparisons of the two membrane processes indicate that: the two desalting applications are competitive with each other; with low salinity brackish waters (under 5000 ppm TDS), ED has a slight advantage over RO; capital costs and operating costs for ED systems decreases more rapidly with increasing plant size; and, RO is not as sensitive to variations in feed salinity as ED. Actual operating and capital costs at several large municipal plants show that local conditions such as plant load factors or fouling problems cause much variation. Both reverse osmosis and electrodialysis are recommended for future usage.

*Waste water treatment, *Facilities, *Municipal water, Membrane processes, Electrodialysis, Reverse osmosis, Capital costs, Operating costs, Design, Economics, Desalination

D181
NITROGENOUS CHANGES DURING THE SETTLEMENT OF SEWAGE,

Stones, T.

Water Pollution Control, Vol. 74, No. 2, p 234-235, 1975. 1 tab, 3 ref.

It is known that there is a reduction in organic nitrogen during settlement of sewage. Two theories to account for this phenomena are that the reduction is due to biological activity, independent of settlement, or that reduction is due to conversion of part of the organic nitrogen to ammonia. In a test, the amounts of ammoniacal and organic nitrogen present were determined for samples of sterilized and unsterilized sewage, both when fresh and when 18 hours old. On the average, organic nitrogen was reduced by 48.8% during settlement for 18 hours. However, 32.5% of this was independent of settlement, implying that only 16.3% was actually due to deposition. An increase of 25.0% in the amount of ammoniacal nitrogen present was clearly due to the decomposition of nitrogenous organic matter. The resulting reduction in the total amount of nitrogen effected by settlement was only about 8%. As there was no change in nitrogenous constituents of sterilized samples, the effects of biological activity are confirmed. In routine analysis of sewage in a facility, samples are 24 hour composites compounded hourly from individual samples, with varying degrees of conversion of organic nitrogen to ammonia having occurred. Thus, although an increase in ammonia concentration is noted in sewage settlement, exact changes taking place in nitrogenous constituents of sewage during passage through sedimentation tanks is not usually measured.

*Waste water treatment, *Sewage treatment, *Nitrogen, Organic compounds, Sedimentation basins (waste disposal), Ammonia, Facilities

Organic nitrogen, Sedimentation tanks

D182
WATER POLLUTION PROBLEMS IN SALISBURY, RHODESIA: PRESENT AND FUTURE,

Wells, C. G.

Water Pollution Control, Vol. 74, No. 2, p 120-123, 1975. 1 ref.

Overall water pollution problems in Salisbury, Rhodesia, are presented, as well as proposals for the future. Between 1950 and 1973, there has been a large increase in population, water consumption, and sewage flow, which has strained both financial and natural resources. The region is on a watershed within the catchment area of its water supply, consisting of the Hunyani River and three tributaries and Lake McIlwaine. It was determined that treated sewage effluents are the major cause of pollution. The regional Council decided that the municipality should be responsible for collection, treatment, and disposal of all Salisbury area sewage; treatment will be concentrated at four works with the largest gravity drainage, close to agricultural land; outfall sewers will be constructed draining to the new treatment facilities; schemes for irrigation of land with sewage effluents will be developed; and continued hydrobiological research will be conducted, as well as studies on chemical treatment of sewage. A combination of biological and chemical treatment and irrigation were formulated such that: during the dry season, all flow will be treated biologically, with effluent being applied to land; and, during the wet season, flow will be treated biologically up to the amount to be irrigated or stored, with excess flows to be treated chemically as raw sewage, with treated effluents being discharged to the river.

*Waste water treatment, *Sewage treatment, *Water pollution control, Sewerage, Facilities, Biological treatment, Land management, Irrigation, Water supply, Rivers, Lakes

Rhodesia, Africa, Chemical treatment, Land application

D183
AERATION DEVICES: THE MANUFACTURER'S VIEWPOINT,

Greig, I. R. M.

Babcock and Wilcox of Africa Limited,
Ames Crosta Division

Water Pollution Control, Vol. 74, No. 2, p 191-192, 1975. 2 ref.

Technical specifications for sewage treatment systems utilizing aeration are discussed, in particular those used in South Africa. The current practice used is extended aeration. The system involves only one basic process line with long retention in the aeration tanks, and limited experience is necessary for operation of facilities. Also, extended aeration offers economic advantages over conventional plants in construction costs. Problems with extended aeration include sludge development with poor settling characteristics due to denitrification and a predominance of filamentous organisms. Also, the sludges produced by this process are voluminous, and difficult to consolidate and dry. Since 1966, however, aeration has been the predominant process for activated sludge treatment. Facilities are being designed for nitrification and biological denitrification within the same plant. The relationship between equipment and tank design is critical because different aerators have very different operational characteristics. Oxygenation efficiency of an aerator is directly related to volume of the aeration tank. Depth is the most important criterion and most manufacturers prefer shallow (up to 3 m) tanks to eliminate the use of baffles, bottom mixing turbines, or draught tubes. It was concluded that aeration tank design should be decided by the mechanical equipment supplier in order that the most suitable geometry be chosen for a particular aerator design.

*Equipment, *Aeration, *Waste water treatment, *Sewage treatment, Facilities, Sludge, Design criteria, Tanks, Construction costs, Sludge disposal, Economics

*South Africa, Extended aeration, Aeration tanks

D184
SIMPLIFIED WASTE WATER PURIFICATION THROUGH PHYSICAL-CHEMICAL TREATMENT (VEREINFACHTE ABWASSERREINIGUNG DURCH PHYSIKALISCH-CHEMISCHE BEHANDLUNG),

Dietrich, K. R.

Wasserwirtschaft, Vol. 65, No. 5, p 125-129, May, 1975. 1 fig, 4 ref.

Physico-chemical treatment of sewage is described as characterized by flocculation, precipitation, absorption, and flotation. Chemicals are applied successively and have a high reaction capacity with colloids by opposite charging. They also have a high adsorptive capacity for the oxygen depleting dissolved organic matter found in sewage. Flotation is a result of oxidation with air in the presence of chemicals acting as catalysts. The subsequent result is an improvement of drainage ability of silicate sludge.

*Waste water treatment, *Sewage treatment, Flotation, Precipitation (chemical), Flocculation, Adsorption, Drainage

*Physico-chemical treatment

D185
NITROGEN REMOVAL IN A PILOT PLANT,

Ericsson, B.

VBB Vattenbyggnadsbyran,
Consulting Engineers and Architects,
Stockholm, Sweden

Journal of the Water Pollution Control Federation, Vol. 47, No. 4, p 727-740, April, 1975. 9 fig, 2 tab, 18 ref.

Nitrogen removal is used as an alternative to phosphorus removal in limiting algal growth. While the method chosen depends on the type of water and dissolved nitrogen compounds, concentrations, and associated costs, the most promising method in Sweden is biological nitrification-denitrification. Results from a pilot plant operation demonstrated that biological nitrification in a tank system is best accomplished by a double sludge system for combined and separate carbon degradation and nitrification. Critical rate of nitrification at 95% yield was found to be about 3.0 and 2.2 mg NH3-N/hr/g vss at 18 C and 12 C, respectively. The BOD:NH3-N ratio after pre-sedimentation influences the oxygen requirement, the sludge yield and the acid produced; pH is also very important. The rate of denitrification in the anaerobic filter with plastic media at about 95% yield during the first period at 18 C was about 9 g NO3(-)-N/hr with a 1.8 hour detention time. The choice between a tank reactor and an anaerobic filter for denitrification depends upon costs and upon operational safety. While the anaerobic filter proved to be safer during the operational trial, it was more expensive. It was recommended that further experimentation be conducted to improve the sludge settleability in the tank reactor system and that the system be compared with flotation.

*Nitrification, *Denitrification, *Waste water treatment, Pilot plants, Filters, Tanks, Sludge, Costs

Phosphorus removal, Sweden

D186
INDUSTRY AND COMMUNITY IN COOPERATION,

Nilsson, L.

K-Konsult,
Lund, Sweden

Journal of the Water Pollution Control Federation, Vol. 47, No. 4, p 760-763, April, 1975. 4 fig.

A successful combined municipal/industrial waste water treatment facility is described. The plant was designed for the township of Kagerod, Sweden and a milk products industry. The township's population, under 2000, produces about 270 lb of biochemical oxygen demand per day. Industrial waste water is expected to average 1000 lb BOD per day, corresponding to 7500 person equivalents. Average daily flow for the new treatment plant will accomodate 4950 cu ft/hr, 1030 cu ft/hr of this from the milkfood plant. The facility uses biological treatment with the activated sludge method and chemical post precipitation treatment with alum. Sludge is dried with industrial smoke and a Nateko dryer. Operation results since 1972 have been very efficient; water emitted from the plant showed a remainder of 22 mg BOD/gal, 27 mg nitrogen/gal, and 0.9 mg phosphorus/gal, or a reduction of 99, 89, and 99%, respectively. The dryer is successful in sulfur reduction as well. The dryer makes it possible to use heating oils with a high sulfur content and still emit less sulfur, thus decreasing costs of heating oil. The results of this system are a economical advantage for both industry and the municipality and a cleaner living environment.

*Waste water treatment, *Facilities, Municipal wastes, Biochemical oxygen demand, Biological treatment, Alum, Economics

Sweden

D187
WASTEWATER TREATMENT PLANT ODORS: A CONTINUING ENIGMA,

Neufeld, R. D.

Pittsburgh University,
Pittsburgh, Pennsylvania,
Department of Civil Engineering

Public Works, Vol. 106, No. 3, p 83-84, 107, March, 1975. 1 tab, 22 ref.

One major problem in the operation of both domestic and industrial waste water treatment plants is the control of odors. The Allegheny County Sanitary Authority (ALCOSAN) has built a treatment network for coping with this problem. Because of the complexity of odorants from various sources, six general classifications of techniques for abatement of odorous air have been defined. These are: combustion; adsorption; absorption; vapor mixing; source reduction; and dilution. Source reduction is a difficult defense against odors, and dilution of odors by discharge through tall stacks into the atmosphere is an alternative which has been discouraged. Combustion for complete destruction of organics requires high temperatures for a sufficient time period. Adsorption with activated carbon requires a system design which accounts for the variety of potential odorants, and determines the offending chemical which is most poorly retained on the carbon. Absorption or scrubbing is suitable only when odorous vapors are soluble, reactive, or emulsifiable in water. Also, organic compounds which comprise most of the odor producing substances in waste are insoluble without the addition of oxidants. Vapor mixing with odor masking or odor modification is controversial as it is not always successful and it does not reduce the atmospheric burden of organic gases but rather increases it. ALCOSAN is presently most concerned with fecal odor from sewage sludge processing; gases from filters will be ducted into existing incinerators, other control will require chemical oxidation.

*Waste water treatment, *Industrial wastes, *Odors, *Municipal wastes, Facilities, Absorption, Adsorption, Organic compounds, Pollution abatement

Allegheny County Sanitary Authority (ALCOSAN)

D188
WATER CONSERVATION IN SWEDEN: III. CURRENT TRENDS,

Lundkvist, S.

Ministry of Agriculture,
Sweden

Journal of the Water Pollution Control Federation, Vol. 47, No. 4, p 673-674, April, 1975.

The Swedish government passed The Environment Protection Act in 1969, requiring that dischargers of municipal waste water as well as of industrial effluents have a permit. Government subsidies of waste water treatment plants seven years ago have led to large-scale construction and increased efficiency. The problems of water management are improving water conditions, stopping further pollution, and repairing present damages. Because 80 percent of Swedish water consumption is industrial, between 1970 and 1974, 275 million dollars were invested in industrial pollution control, 102.5 million of this as government subsidies. A dramatic decrease in pollution discharge has resulted; for example, BOD has decreased by 520 tons per day. Use of DDT and PCB has also been regulated and curtailed. Oil pollution has been a major water conservation problem. The Swedish Coast Guard, which registers about 250 oil spills per year, has increased its harbor facilities for handling oily wastes and has developed special vessels and depots to deal with the problem. Mercury discharges, which had made fish unfit for human consumption, have been reduced since 1967 from 30 to 40 tons per year to present levels of 800 kg per year. Other marine research has been conducted on water exchange and material balance on lakes, rivers, and groundwater. Lake restoration methods in several areas have used mechanical removal of vegetation and sediments, chemical treatment with flocculants to reduce organic matter and nutrients, oxygenation of bottom waters, and biological methods. Continued environmental protection of Sweden's coastal waters is being provided by agreements with neighboring countries, on its western coastlines and on the Baltic.

*Waste water treatment, *Waste disposal, *Water quality, *Oil pollution, *Water conservation, Governments, Permits, Water pollution control, Potable water, Aquatic life,

D189
CARBON REGENERATION BY WET AIR OXIDATION,

Gitchel, W. B., Meidl, J. A., and Burant, W., Jr.

Zimpro, Incorporated,
Rothschild, Wisconsin

Chemical Engineering Progress, Vol. 71, No. 5, p 90-91, May, 1975. 1 fig, 1 tab, 12 ref.

The results of physical and chemical tests and full-scale plant tests on the water quality produced by wet air oxidation regenerated activated carbon are summarized. The quality of the water produced by the regenerated carbon was found to be equal to the best obtained by using virgin carbon. Results indicate that wet air oxidation causes some reduction of surface in pores under 10 angstroms radius while increasing surface in all other pores. Absorption isotherms show that most C1-C4 compounds are not adsorbed even by virgin carbon with a full compliment of surface in the smallest pores. These small carbon compounds are readily removed by biological treatment, suggesting therefore that the surface in 10 angstrom or smaller pores is not essential in waste water treatment. The chemical and physical tests show that wet air oxidation does restore all the adsorbate relative efficiencies (R. E.) and pore structure of the parent carbon to a very high degree with the exception of the mentioned small pores. It is concluded that spent carbons may be fully regenerated by wet air oxidation in terms of the application of these carbons.

*Waste water treatment, *Activated carbon, Adsorption, Tertiary treatment, Laboratory tests, Sewage treatment, Physical properties, Water quality

Wet air oxidation, Carbon regeneration

D190
LAMELLA SEDIMENTATION: A COMPACT SEPARATION TECHNIQUE,

Forsell, B., and Hedstroem, B.

Axel Johnson Institute for Industrial Research,
Nynaeshamn, Sweden, Engineering Department

Journal of the Water Pollution Control Federation, Vol. 47, No. 4, p 834-842, April, 1975. 12 fig, 3 ref.

Lamella sedimentation has the advantages of reducing the demand for large building areas and/or volumes and also of low operating and overall costs. Modern lamella sedimentation techniques have profited from advances in fluid dynamics research and materials technology. A general description of lamella sedimentation is given with reference to the topics of surface effectiveness and compactness, sludge density, sludge volume and resistance to shear forces, flow variations, fluid mechanics, special problems of lamella sedimentation, and the mechanical construction and layout of a lamella sedimentation plant. The area that is theoretically available for separation in a lamella apparatus is equal to the sum of the projections on the horizontal plane of the separation plates. In a continuously working separator, a large enough inclination angle must be chosen so that the sludge separating on the plates may be continuously and efficiently removed. Flow pattern can be either cocurrent or counter current; the choice depends on the fraction of the sludge volume which is light, network forming, low yield stress and which is heavy, finely dispersed, high yield stress. A lamella sedimentation plant consists of a particular number of separating plates working in parallel, large plants may contain several thousand. Smaller plants, less than 250 sq m, may be designed as package plants. In larger plants, the lamella device is usually one step in a process line in which all units are contained in a common concrete building block.

*Waste water treatment, *Sedimentation, *Settling basins, Separation techniques, Equipment, Sludge treatment

*Lamella separators

D191
CHEMICAL-BIOLOGICAL TREATMENT WITH BIOLOGICAL FILTERS,

Neeley, A. B.

Water Pollution Control, Vol. 74, No. 2, p 160-165, 1975. 2 ref.

Pilot scale experiments with lime addition at the primary stage of a conventional works is discussed. The objective of the study was to find a process which could initially be used on a seasonal basis, requires little capital expenditure, and can be used with existing treatment facilities. A pilot facility was tested at Salisbury, Rhodesia, after laboratory study. Lime precipitation with recarbonation enabled the filter to work well. Costs for lime storage, dosing, and pH control were low; major capital expenditure would be necessary only if denitrification, suspended solids removal and sludge recalcining were needed. It was concluded that conventional biological filter plants could be converted for phosphate removal at low cost, without excessive revenue expenditure. Under certain circumstances, it might be economic to use lime to reduce overload on a works rather than to extend it. If phosphate removal was needed on an overloaded works, the process would be very economical. Effluents from this system would be well suited to treatment by denitrification. Because necessary installation would not interfere with normal operation, the system is applicable for seasonal use in conjunction with a farm.

*Biological treatment, *Waste water treatment, *Lime, Pilot plants, Facilities, Capital costs, Filters, Phosphates, Denitrification, Operation, Sludge treatment

Phosphate removal, Recarbonation

D192
AERATION BY MEANS OF BLAST NOZZLE--A POSSIBILITY FOR THE AERATION OF BIOLOGICAL WASTE WATER TREATMENT PLANTS (DIE STRAHLDUESENBEGASUNG--EINE MOEGLICHKEIT ZUR BELUEFTUNG BIOLOGISCHER KLAERANLAGEN),

Daucher, H-H., Kroetzsch, P., Popp, K. H., and Stickel, R.

VDI-Berichte, No. 218, p 239-249, 1974.

A blast nozzle aerator and its use for the aeration of activated sludge in biological waste water treatment plants is described. Blast nozzles are placed horizontally near the bottom of the aeration tank. These blow air, oxygen-enriched air, or oxygen into the water, while performing a rotary motion due to the tangential arrangement of the nozzles. The rotary motion provides for necessary circulation of the water. At an immersion depth of 1.6 m, the oxygen input ranges from 1.5 to 2.5 kg of dissolved oxygen per kWh, while nozzles with 4 m immersion reach oxygen inputs over 4 kg/kWh. The blast nozzles are equally suitable for the aeration of municipal and industrial waste water.

*Waste water treatment, *Aerators, *Activated sludge, Facilities, Oxygen, Municipal wastes, Industrial wastes, Aeration, Equipment

D193
LIQUID CO2 PROTECTS OUR WATER'S QUALITY,

Boyd, D. R.

Kansas City Water Department,
Kansas City, Missouri

The American City, Vol. 90, No. 1, p. 57-58, March, 1975. 2 fig.

The Kansas City, Missouri, Water Department utilizes recarbonization as an essential step in their water purification method. This step is used to neutralize and stabilize the water after it has been softened with lime. In the past the Kansas City plant produced their own carbon dioxide with on-site generators. They are now using commercial carbon dioxide. The advantages of using liquid carbon dioxide are cost, superior purity and quality of gas, no contamination of the water, shorter filter runs, and prevention of carbon monoxide formation. The Kansas City plant processes an average of 105 mgd with a high of 178 mgd and low of 85 mgd using an average of 339 pounds of carbon dioxide vapor per million gallons of water for recarbonization. The liquid carbon dioxide is stored in 4 fiberglass insulated refrigerated low-pressure tanks with a 24-ton capacity each. In the recarbonization basins the water passes in an undulating motion over and under a series of transverse verticle baffles. The excess alkalinity of the water is neutralized to a pH of 9.7 by the carbon dioxide.

*Water quality, *Carbon dioxide, *Water purification, Costs, Lime, Flow rates, Water treatment

*Recarbonization, Kansas City, Missouri

D194
VIRUS REMOVAL AND INACTIVATION DURING WATER TREATMENT,

Sproul, O. J.

Maine University,
Orono, Maine,
Department of Civil Engineering

Journal of the New England Water Works Association, Vol. 89, No. 1, p 6-15, March, 1975. 5 tab, 12 ref.

The increased use of water for recreational purposes has made it necessary to decrease the viruses in water after treatment. Coagulation and sedimentation, rapid sand filtration and disinfection in a series are used by a complete water treatment plant. Removal of poliovirus one can be as high as 99.9% when magnesium is precipitated from the water. Coagulation has also resulted in a high virus removal rate. Filtration through sand can remove viruses completely from treated waste water effluent provided the distance is long enough. Chlorine used properly is an effective viricide. Ozone is also an effective disinfectant. In the future research and development to minimize effects on the environment from viruses through treatment plants would be useful. Standards for treating potable and waste water should also be developed.

*Waste water treatment, *Treatment facilities, *Viruses, Coagulation, Sedimentation, Filtration, Disinfection, Chlorine, Ozone, Recreation, Environmental effects

Viral removal, Virus inactivation

D195
ACTIVATED CARBON IN THE WATER TREATMENT PLANT,

Sylvia, A. E.

Massachusetts Department of Public Health,
Lawrence Experiment Station,
Lawrence, Massachusetts

Journal of the New England Water Works Association, Vol. 98, No. 1, p. 29-35, March, 1975.

Coal is the source of granular activated carbon commonly used by water treatment plants. Public health officials are concerned not only by the odor and taste problems but also by the chemicals from industrial plant effluents and natural surface runoff entering the public water supply. Activated carbon beds and columns will adsorb the chemicals most concerning the public health officials as potential health hazards. The Environmental Protection Agency has been trying to pass a bill that would extend their authority beyond bacteriological quality of water supplies to include physical, chemical, and biological standards. Passage of this legislation would mean that a number of water districts would have to use additional treatment to meet the standards. Carbon Chloroform Extract (C.C.E.) is high on the EPA list. Work is being continued on the development of a rapid fluorescence technique. The method has undergone extensive testing and seems to be valid for measurement of microorganisms in potable water when compared to the CCE method.

*Activated carbon, *Treatment facilities, *Waste water treatment, *Water quality standards, Public health, Legislation, Industrial wastes, Surface runoff, Odor, Taste, Potable water, Microorganisms

Carbon chloroform extract, Rapid Fluorescence Technique, Environmental Protection Agency

D196
HIGH COSTS MODIFY SEWAGE PLANT EXPANSION,

Engineering News-Record, Vol. 194, No. 15, p 81-82, April 10, 1975. 3 fig.

Rising construction and energy costs have forced a slowdown in the plans to expand and upgrade by installing an advanced waste treatment system that would remove nitrogen and phosphours at Washington, D.C.'s Blue Plains sewage treatment plant. The present facility is a modified activated sludge plant handling an average flow of 250 mgd with a peak of 300 mgd with a secondary treatment process removing 70% BOD and suspended solids. The upgraded plant would handle 309 mgd with a peak of 650 mgd and the new modified aeration plant will remove 95.5% BOD, 98% phosphorus and nitrogen and 90% ammonia. Because of Blue Plains' proximity to the Potomac tidal estuary, the removal of both nitrogen and phosphate was believed necessary to end growth of blue-green algae which has on occasion matted and caused fishkills. If phosphorus removal could slow the growth, construction costs would be lower. Sludge disposal presents another problem. Incineration of the sludge according to present plans would require 50 million kwh of electricity and 13.7 million gallons of fuel oil in 1978. Presently the sludge is being disposed of by burying and surface land disposal. Another solution is selling composted sludge for fertilizer providing the odor problem can be overcome.

*Waste water treatment, *Construction costs, *Treatment facilities, Flow rates, Costs, Potomac River, Biochemical oxygen demand, Nitrogen, Phosphorous compounds, Estuaries, Cyanophyta, Fishkill, Sludge disposal, Tertiary treatment

Washington, D. C., Blue Plains Sewage Treatment Plant

D197
THE INFLUENCE OF TEMPERATURE ON THE BIOLOGICAL OXIDATION OF URBAN WASTE WATERS BY MEANS OF AN ACTIVATED SLUDGE (INFLUENZA DELLA TEMPERATURE NELLA OSSIDAZIONE BIOLOGICA DEI LIQUAMI URBANI MEDIANTE FANGHI ATTIVI),

Bolla, M., and Dini, G.

Rassegna Chimica, Vol. 26, No. 3, p 155-158, May/June, 1974. 2 fig.

The influence of temperature, activated sludge concentration, and retention time on the biological oxidation of organic matter in urban waste water was studied. The BOD5 values were found to decrease with increasing temperature in the studied temperature range of 10 to 20 C. The rate of nitrification was a function of the temperature, the hold time, and the activated sludge concentration. At an activated sludge concentration of 4700 to 6000 ppm, a retention time of 3 to 4 hours was required at 18 C. At an activated sludge concentration greater than 6000 ppm, the reaction time must be 4 hours and the temperature 15 C. With the activated sludge concentration under 6000 ppm, the reaction time must be increased accordingly. Diagrams for the determination and coordination of the activated sludge concentration, temperature, and retention time for a given residual BOD value or ammonium nitrogen content are presented.

*Waste water treatment, *Activated sludge, Water temperature, Biological treatment, Organic matter, Municipal water, Biochemical oxygen demand, Nitrification

D198
A SURVEY OF THE TOKYO METROPOLITAN SHIN-KASHI TREATMENT PLANT,

Nagahama, T.

Gesuido Kyokai-shio, Vol. 11, No. 125, p 67, 1974

The Tokyo Shin-Kashi sewage treatment plant, an advanced and final stage treatment plant which is needed to keep the water quality to a pH between 5.8 to 8.6 to below 20 mg/liter for BOD, and to below 70 mg/liter for SS, is described. The plant treats both municipal waste water and treated industrial waste water which have flowed into the plant through separate drainages. The total input of water to the plant is 380,000 cu m/day and expected to increase to 940,000 cu m/day with the completion of other drainages now under construction. The industrial waste water is pre-treated separately from the municipal waste water. A pH adjustment, additional aeration treatment, and chemical precipitation treatment are given to the industrial water before mixing it with municipal waste water at a pre-aeration tank. The mixed waste water is fed into a primary precipitation pond, then an aeration tank, a final-precipitation pond, and a chloride mixing tank. The purification efficiency of waste water in this plant is much higher than those plants treating the mixture of both municipal and industrial water without industrial water pre-treatment. Both operational and dimensional details of individual treatment facilities are also presented.

*Waste water treatment, *Sewage treatment, *Industrial wastes, Municipal wastes, Precipitation (chemical), Facilities

Tokyo, Japan

D199
OUTLINE OF TAGAWA SEWAGE PLANT IN UTSUNOMIYA CITY,

Koike, I., and Saito, N.

Gesuido Kyokaishi, Vol. 12, No. 129, p 72-76, February, 1975. 1 fig, 3 tab.

Since 1965, the Tagawa plant in Utsunomiya City Japan, has been treating its municipal sewage water. With an added capacity of its facility in 1970, the plant now treats waste water for a population of 125,000. The sewage water is passed through several screens to remove large objects before entering a sand-precipitation pool. It is then pumped into a first-precipitation pool and stays for 1 3/4 hours in the pool. The supernatant water then enters into an aeration tank, a final-precipitation pool, and a chloride mixing pool, before being discharged into the Tagawa River. During wet weather, the aeration and final-precipitation steps are skipped, and the supernatant water is sent directly to the chloride mixing pool. Sludges produced during precipitation and aeration treatment are sent to a sludge concentration tank. After dehydration of the treated sludges, they are sent to an incineration furnace and combusted at 800 to 1000 C.

*Waste water treatment, *Sewage treatment, *Facilities, Municipal wastes, Sludge treatment, Precipitation (chemical), Aeration, Chlorine, Dehydration, Incineration

Japan

D200
BALANCING RESERVOIR--A KEY ELEMENT IN WATER SUPPLY PLAN,

Freese, L. B.

Freese and Nichols,
Consulting Engineers,
Forth Worth, Texas

Public Works, Vol. 106, No. 5, p 104-105, May, 1975. 1 fig.

The water supply of Fort Worth, Texas has come from impounded river sources for over fifty years. A long term plan, the Cedar Creek Project, was developed to increase the quantity and treatment of water impounded. The plan involved the Cedar Creek Reservoir, 80 miles southeast of Forth Worth; an intake pump station at the reservoir; 68.2 miles of 72-inch pipeline and associated pump stations, which reach from the reservoir intake to a balancing reservoir at the end of the 72-inch section of the pipeline; a balancing reservoir with a future capacity of 300 million gallons; and, 6.1 miles of 84 inch pipeline, connecting the balancing reservoir to the site of Fort Worth's Rolling Hills Treatment Plant. This $9.5 million plant was designed so that total capacity could be doubled without adding chemical facilities or increasing the number of administrative or laboratory buildings, and with the instrumentation for future computer control. The balancing reservoir, located six miles from the water treatment station, is situated on a hilltop so that a gravity line could be run without energy loss. Because this balancing pond is located so close to the city, a fail-safe lining was necessary. The large--620 feet square at the base and 875 feet square at the perimeter--reservoir was lined with an impermeable membrane of nylon-reinforced "Hypalon" synthetic rubber. The material is reinforced with a single layer of nylon scrim, offers improved strength and dimensional stability, is not adversely affected by soil chemicals, microorganisms, and is resistant to ozone and uv light. The costs of the project was $850,000, with $250,000 of this for the liner.

*Water supply, *Pipelines, *Reservoirs, Rivers, Water treatment, Facilities, Construction materials, Synthetic rubber, Texas

D201
PACKAGE PLANT OWNER RESPONSIBILITY AND OPERATION OF SMALL SEWAGE UNITS,

Nicolle, N. P.

Water Pollution Control, Vol. 74, No. 2, p 199-200, 1975.

The necessary care and maintenance of package plant small sewage units is described. The major required daily duty is removal of gross solids to prevent sewage from backing up or overflowing, particularly in the openings of valves and pumps. Package plants of the conventional biological filtration type and extended-aeration units with aerobic digestion are the two basic types of package plants available for small communities. Quality control for the conventional unit requires the daily determination of settleable solids in primary sedimentation tank effluent as well as from humus tanks or sand filters and determination of residual chlorine which may be present in effluent entering the contact tank. On a monthly or three-monthly basis, values should be measured of: 4-hour permanganate value; COD, ammonia nitrogen, suspended solids, fecal E. coli, and methylene blue stability. For the extended aeration units, daily determination must be made of settleable solids in effluent, MLSS concentration by centrifuge, and residual chlorine in the final effluent. The final effluent should be checked monthly for SS, 4-hour permanganate value, COD, ammonia nitrogen, fecal E. coli, and methylene blue stability. For both types of packages, cleaning is necessary of filters, screens, pipes, drying beds, tanks, and other surfaces. Other specific maintenance recommendations are given, in order to keep the unit at peak performance.

*Waste water treatment, *Sewage treatment, *Maintenance, Aeration, Biological treatment, Filters, Facilities, Sewage effluents

*Package plant sewage units, Effluent control

D202
PHOSPHATE PRECIPITATION IN ACTIVATED SLUDGE PLANTS WITH SLUDGE STABILIZATION AND DENITRIFICATION (PHOSPHATFAELLUNG IN BELEBUNG-SANLAGEN MIT SCHLAMMSTABILISATION UND DENITRIFIKATIONSSTUFE),

Kienzle, K. H.

Vom Wasser, Vol. 42, p 329-369, 1974. 16 fig, 9 tab, 14 ref.

Activated sludge plants with sludge stabilization were studied both in laboratory scale plants and in a full scale oxidation ditch. The study investigated the influence of precipitation of phosphate on both the purification effect and the nitrogen elimination efficiency. Phosphate elimination due to adding ferrous (III)-chloride was found not to be sufficient. The precipitant caused a lowered pH value in the plants and negatively influenced the activated sludge. Thus, the purification efficiency of the plants decreased, particularly regarding BOD5 degradation and nitrogen elimination. With alum precipitation, the efficiency was over 90%, with effluent concentrations of less than one mg total phosphorus per liter. In this case, BOD5 and nitrogen elimination were not negatively influenced. It was concluded that a low nutrient content in the effluent of activated sludge plants with sludge stabilization and a pre-step denitrification may be obtained by the simultaneous addition of aluminum for phosphate precipitation.

*Activated sludge, *Waste water treatment, Phosphate, Nitrogen, Alum, Efficiency, Precipitation (chemical), Biochemical oxygen demand, Facilities, Denitrification, Oxidation

D203
ALTERNATIVE METHODS OF DISINFECTION,

Roberts, K. J.

Water Pollution Control Branch, Ontario Ministry of the
Environment, Toronto, Ontario, Canada,
Water Technology Section

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, British Columbia, p 183-193. 2 fig, 1 tab, 18 ref.

Alternatives to chlorine disinfection of waste water, such as dechlorination, chemical oxidation, ultraviolet and gamma ionizing radiation, are examined. Dechlorination is the removal of all or part of the total chlorine residual through the addition of sulfur dioxide or other sulfur bearing compounds. Chemical oxidation can be accomplished by the application of ozone or chlorine dioxide. Ozone is a powerful oxidizing agent, an efficient disinfectant, and leaves a beneficial dissolved oxygen residual. The bactericidal efficiency of chlorine dioxide has been shown to be comparable to that of chlorine in the neutral pH range and increasing significantly with pH. Ultraviolet radiation does not appear to be a feasible method for disinfection of waste water because the water to be treated by UV must be free of suspended particles that would act as a shield to keep the electromagnetic waves from actually striking and killing the organisms. A pilot plant study for the disinfection of activated sludge effluent by gamma irradiation is presented in detail. Results show: coliform organisms are the most sensitive to irradiation treatment; good disinfection can be achieved with the application of a dose of 100,000 rads; the disinfecting process is reliable because the applied radiation is constant and predictable; and, the effluent from the irradiation reactor was nontoxic to fish. Each method of treatment has its own advantages and disadvantages as well as the fact of increased cost over chlorine treatment.

*Disinfection, *Waste water treatment, *Chlorination, *Ozone, Gamma rays, Ultraviolet radiation, Oxidation, Pilot plants

Chemical oxidation, Chlorine dioxide

D204
METRO CHICAGO STUDIES ON NITRIFICATION,

Lyman, B. T., Zenz, D. R., Lue-Hing, C., Richardson, G. R.,
and Washington, B. T.

The Metropolitan Sanitary District of Greater Chicago,
Chicago, Illinois

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 449-503. 17 fig, 5 tab, 6 ref.

Nitrification in the Chicago area was tested at three facilities. A two-stage nitrification at Hazlecrest, Illinois, produced an effluent high in nitrate-nitrite and low in ammonia concentrations at a 3.0 to 5.0 hour detention time in the second stage. Temperature effects were a major factor for both initiating and maintaining nitrification. At the Calumet Sewage Treatment Plant, a pilot plant in Chicago, process steps included preliminary and secondary treatment, anaerobic sludge digestion, and contact chlorination. Results of this system indicated that under such a second-stage nitrification system, a nitrified effluent with an ammonia nitrogen residual of under 2.5 mg/liter could be produced with: influent NH3-N, 10 to 25 mg/liter, SRT of at least ten days, and a minimum operating temperature, 12 to 15 C. A Water Reclamation Plant at Lemont, Illinois, used nitrification and employed extended aeration. When operated at long detention times, with sewage temperatures as low as 45 F, a well-nitrified effluent was produced. The concept of single-stage nitrification at all major plants in the Chicago area is being tested at pilot scale levels. A new plant under construction at West-Southwest will have a maximum flow capacity of 26 mgd, detention time, 5.5 hours, with return sludge flow capability of 26 mgd. The Metropolitan Sanitary District of Greater Chicago policy toward nitrification at future full-scale plants has not yet been decided.

*Nitrification, Ammonia, Nitrogen, Waste water treatment

*Chicago (Ill.)

D205
HEAT TREATMENT OF SEWAGE SLUDGE,

Saito, K.

Public Works Research Institute,
Ministry of Construction, Japan,
Sewage Works Section

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 20-64. 6 fig, 12 tab.

Results of a three-year investigation of facilities for heat treatment of sewage sludge are presented. Care must be taken for prevention of corrosion and organic deposition. Heat treated sludge dewaters easily and can be burned without the use of additional fuel. However, three major problems of this method persist. These are: removal of odors from the treatment process; treatment of supernatants having high BOD, including removal of nitrogen compounds and heavy metals; and the need to establish operation and maintenance systems for periodic inspection. In order to implement a heat treatment system, optimum operating conditions must be determined by quality of supernatant for each particular sewage treatment facility. It is desirable to establish a closed system for heat treatment, where heat from incineration of the cake is recycled and odorous gases are reused as combustion air for complete deodorization. In addition, it is recommended that equipment be standardized in order to simplify the facilities for quality control and cost reduction.

*Sewage treatment, *Sludge treatment, *Heat treatment facilities, Dewatering, *Waste water treatment, Maintenance, Recycling, Equipment, Costs, Sludge

Japan, Odor removal

D206
COMBINED TREATMENT OF MUNICIPAL AND INDUSTRIAL WASTEWATER,

Sato, M., Fujii, H., and Yasuda, S.

Sewage Works Bureau,
Yokohama City, Japan

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 65-127. 12 fig, 24 tab.

Systems for combined treatment of municipal and industrial waste water require consideration of technical knowledge, expense allotment, and administrative measures. Factors concerning combined treatment are discussed for systems with and without pre-treatment of industrial waste waters. Described are the Torihama industrial waste water pre-treatment plant, the combined treatment of industrial and domestic waste water at Shingashi Valley, and the combined treatment of industrial and municipal waste water in Kyoto. In the Kyoto treatment plant, comparisons between pure oxygen aeration and the conventional air system demonstrated that pure oxygen aeration is useful for treatment of highly polluted sewage with a variable load.

*Waste water treatment, *Pre-treatment, Industrial wastes, Municipal wastes, Facilities, Aeration, Oxygen

*Combined municipal-industrial waste treatment, Kyoto, (Japan)

D207
STUDIES ON ADVANCED WASTE TREATMENT,

Kashiwaya, M., and Nanbu, S.

Ministry of Construction,
Japan,
Water Quality Section, Public Works Research Institute

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 125-188. 24 fig, 17 tab, 4 ref.

Results of laboratory and pilot scale tests concerning lime precipitation in municipal waste water are given from two areas in Japan. Pilot plant installations at the Shita-machi Sewage Treatment Plant in Yokosuka and at the partially completed Toba Sewage Treatment Plant in Kyoto are described. In Japan, 71% of the municipal sewage treatment plants use the activated sludge method. However, organic suspended solids are not always removed from the final settling tanks of this process. The down-flow filtration process is being investigated, as well as an up-flow type granular activated carbon adsprption system. Treatability of waste water may be evaluated, based on water quality matrices; variables used were impurity size, chemical property, and concentration. For removal of organics, three water quality indices were illustrated, involving TOC, E260 millimicrons, and E220 millimicrons connected with impurity size distribution to describe the usefulness of biological treatment, chemical coagulation, carbon adsorption, or other treatment processes.

*Tertiary treatment, *Lime, *Precipitation (chemical), Pilot plants, Municipal water, Activated sludge, Filtration, Adsorption, Suspended solids, Biological treatment

Japan, Water quality matrices, Chemical treatment

D208
TREATMENT AND DISPOSAL OF SLUDGE FROM MUNICIPAL WASTEWATER PLANTS IN THE UNITED STATES,

Farrell, J. B.

National Environmental Research Center,
Environmental Protection Agency,
Cincinnati, Ohio,
Advanced Waste Treatment Research Laboratory

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 223-233. 3 tab, 11 ref.

Various methods used for treatment and disposal of sludge from municipal waste water treatment plants in the United States are described. Because secondary treatment is a national goal, an increase in the amount of secondary and chemical sludges is expected. The largest percent of sewage sludge is disposed to land while a substantial proportion is incinerated with the ash disposed to land. Ocean disposal is not viewed as a favorable method for the future. Types of stabilization are compared, including anaerobic digestion, aerobic digestion, chlorine stabilization, and lime stabilization. Sludge conditioning may be approached by treatment with inorganic chemicals, with polymers, or by heat treatment. Dewatering methods are dependent on solids content; types of filters and centrifuges are described. Guidelines for disposal by means of incineration, landfill, or by landspreading are evaluated as is the economic viability of each alternative.

*Waste water treatment, *Municipal wastes, *Wastes disposal, Sewage treatment, Incineration, Anaerobic digestion, Heat treatment, Equipment, Filters, Centrifuges, Economics

*Sludge conditioning

D209
EXPERIENCES WITH SLUDGE HANDLING IN TEXAS,

Whittington, D.

Texas Water Quality Board,
Austin, Texas

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 239-244. 4 ref.

Sludge handling in small plants in rural areas of Texas is successfully accomplished by anaerobic digestion with dewatering on open beds and subsequent land application. For small plants located in urban areas, a trend is toward aerobic rather than anaerobic digestion. This is due to an extensive usage of contact stabilization treatment plants which run best utilizing aerobic digestion, and various nuisance problems which are associated with anaerobic sludge handling. One technique used in Houston, for transporting excess activated sludge from plants with no dewatering facilities to a sludge processing plant is the pumping of sludge via pressure conduits to a sanitary sewer which then flows to major plants. At larger municipal Texas plants, a variety of sludge disposal techniques have been applied. Descriptions are given of the sewage treatment facilities of the City of Houston, the Gulf Coast Waste Disposal Authority, the City of Austin, and the City of San Antonio. It is predicted that the larger plants in arid areas will continue utilizing sludge lagooning where feasible. Where final disposal is nearby landfill, vacuum filters will be used for dewatering; where ultimate disposal is fertilizer production or long-distance landfill, pressure filters are likely to be used.

*Sludge treatment, *Sludge disposal, *Texas, Waste water treatment, Rural areas, Urban areas, Dewatering, Anaerobic digestion, Activated sludge, Municipal wastes

*Sludge handling, *Land application

D210
SLUDGES GENERATED IN PHOSPHATE REMOVAL PROCESSES,

Farrell, J. B.

National Environmental Research Center,
Environmental Protection Agency,
Cincinnati, Ohio,
Advanced Waste Treatment Research Laboratory

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 271-282. 2 fig, 10 tab, 5 ref.

When aluminum salts, iron salts, and/or lime are used in the physical-chemical treatment of waste water to remove phosphate, the sludge mass increases and dewatering properties are affected. The masses of sludge formed from each treatment can be calculated from chemical equations. Aluminum and iron salts generally reduce the solids content of primary clarified sewage so that sludges cannot be thickened to as high a solids content. With lime, the opposite result occurs. Thickening and dewatering properties are substantially improved and sludge conditioning agents can often be eliminated. While the mass of sludge is generally higher with lime treatment, the volume is often lower than when Al or Fe salts are used. Tests under plant conditions of treatment with these chemicals were conducted at Little River, Ontario, at Blue Plains in Washington, D. C., at Contra Costa, California, and at Salt Lake City, Utah. Results indicated excellent sludge characteristics, such as filter yield and sludge concentration, with lime treatment. Modifications in clarifier design are being investigated to improve Al and Fe sludge treatment.

*Nutrient removal, *Phosphates, *Aluminum, *Iron, *Lime, *Waste water treatment, Dewatering, Pilot plants, Facilities

Physico-chemical treatment, Sludge volume, Thickening, Clarifiers

D211
EPA EXPERIENCES IN OXYGEN-ACTIVATED SLUDGE,

Barth, E. F.

National Environmental Research Center,
Cincinnati, Ohio,
Advanced Waste Treatment Research Laboratory

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 283-357. 26 fig, 26 tab, 7 ref.

The role of the EPA between 1968 and 1974 as the oxygen aeration process was developed is summarized. Facilities from seven projects are detailed. These are: Batavia I and II (Union Carbide Corporation), the purpose of which was to establish the feasibility of a multi-stage, covered-tank oxygenation concept; Newtown Creek (New York City), where scaled-up demonstration of the multi-stage, covered-tank oxygenation system was investigated; Las Virgenes (California) Municipal Water Destrict, which demonstrated the single-stage, covered-tank oxygenation system; FMC Corporation, which hoped to establish the feasibility of the open-tank oxygenation concept; the EPA/District of Columbia (Blue Plains) Pilot Plant, to determine the process kinetics over a wide range of operating conditions; the Bureau of Reclamation, which tested materials of construction for corrosion potential; and the Rocketdyne Division of Rockwell International, which planned to define safety requirements and to develop a safety manual and checklist. As a result of these studies, it was concluded that oxygenation systems are equally applicable to the construction of new facilities and the upgrading of existing secondary treatment plants. Such systems should be designed as integrated packages, with a biological reactor, a secondary clarifier, and sludge handling equipment. Further work should verify or contradict data which indicate that reduced excess biological sludge production is possible with oxygenation.

*Aeration, *Oxygen, *Waste water treatment, Biological treatment, Facilities, Treatment facilities, Sludge treatment, Sludge disposal, Administration

*Environmental Protection Agency, Secondary treatment

D212
AERATION SYSTEMS FOR METRO CHICAGO,

Lynam, B. T., Graef, S., and Wunderlich, D.

The Metropolitan Sanitary District of Greater Chicago,
Chicago, Illinois

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 358-392, 5 fig, 5 ref.

A complete discussion of aeration systems for the greater Chicago area is given. Development of aeration technology involved diffuser plate studies for permeability, uniformity, and diffuser plate rating. More recent work concerned instream aeration, basin aeration, and small plant design and modification. Fine bubble aeration practices, involving intakes, filters, blowers, air mains, and aeration tanks, are detailed. From investigations since 1920, the Metropolitan Sanitary District of Greater Chicago has evolved diffuser permeability criteria, design and operation of primary and secondary air filters, and aeration tank configuration and diffuser placement. Mathematical relationships for oxygen transfer have been formulated. An overall effective economic technology for activated sludge treatment has been developed.

*Aeration, Design criteria, Treatment facilities, Mathematical studies, Activated sludge, Economics

*Chicago, *The Metropolitan Sanitary District of Greater Chicago, Bubble aeration

D213
OXYGEN ACTIVATED SLUDGE SYSTEMS IN TEXAS,

Whittington, D., and Tischler, T. B.

Texas Water Quality Board,
Austin, Texas

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 393-399. 3 ref.

Pure oxygen systems for waste treatment, particularly the Unox Process, are discussed in terms of the applicability of this system to facilities in Texas. Four small to medium size Unox systems are under construction or in planning stages for Texas municipalities. The advantages of this process include reductions in biological reactor volumes, higher oxygen-transfer efficiencies, improved sludge handling characteristics, simplified process control, and odor control. Some possible disadvantages are that the more sophisticated mechanical and electrical control systems may not be operated by all treatment plant personnel. Also, there is a possibility of volatile hydrocarbons entering the enclosed system, which could lead to a serious explosion. For this reason, a monitoring device for hydrocarbons is installed in each Unox unit, and should be properly maintained. Because of reduction of tank volumes and land area needed, the Unox process may be a viable future alternative to conventional activated sludge treatment for Texas. This is especially true in large municipal plants, where an economic advantage results.

*Waste water treatment, *Texas, *Sludge treatment, Odors, Oxygen, Personnel, Operation, Maintenance, Monitoring, Economics, Municipal wastes

*Unox Process, Hydrocarbons, Pure oxygen treatment

D214
SUSPENDED SOLIDS REMOVAL PROCESSES STUDIED AT METRO CHICAGO,

Lynam, B. T., Zenz, D. R., Lue-Hing, C., and Richardson, G. R.

The Metropolitan Sanitary District of Greater Chicago,
Chicago, Illinois

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 400-448. 15 fig, 4 tab.

Metro Chicago has investigated its suspended solids removal processes by full-scale and pilot studies. At Hanover Park, a full-scale evaluation of sand filtration and microstraining was carried out in order to determine maximum suspended solids loading and maximum hydraulic loading to both the sand filter and the microstrainer. Pilot plant studies evaluated three devices, the DeLaval filter, the Neptune Microfloc Unit, and the Graver Filter. All filtration units were proven to be capable of producing effluent suspended solids and BOD of under 10 mg/liter. The Graver pressure filter can be successfully operated at higher hydraulic loadings (9.0 gpm/sq ft) and suspended solids loadings (1.9 lbs/sq ft) than the other two units. The Neptune Microfloc Unit achieved the best effluent quality, with less than 6.0 mg/liter of suspended solids and BOD. A 15 mgd rated capacity microstrainer at the north side treatment works of the District was also evaluated. The various test results were compared, indicating that microstrainer flow capacity is very much dependent upon the type of effluent solids. Additionally, sand filters are capable of achieving better suspended solids removal than microstraining devices, and batch type filters appear to be capable of loadings over 1.2 lbs/sq ft/filter run.

*Suspended solids, *Waste treatment, *Pilot plants, Facilities, Hydraulic properties, Filters, Filtration, Effluents, Equipment

*Hydraulic loading, *Microstrainers

D215
OVERVIEW OF CANADIAN SLUDGE HANDLING AND LAND DISPOSAL PRACTICES AND RESEARCH,

Black, S. A., and Schmidtke, N. W.

Ontario Ministry of the Environment, Toronto,
Canada

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 1-9. 2 tab, 4 ref.

Sludge handling and disposal practices in some major Canadian cities and sludge practices in Ontario are discussed. The most widely used methods of disposal in Canada are anaerobic digestion, followed by placing the sludge in storage lagoons, sanitary landfills, or on agricultural lands without consideration of the environmental effect. Ontario is now involved in a phosphorus removal program. In the most critical areas of the Province the facilities were to have been operation by December 1973, in less critical areas by December 1975, and all other areas three years after notification. Chemical precipitation will be the method used in the phosphorus removal facilities. Research studies included land application of sewage sludges and handling and treatment of sewage sludges under the Canada-Ontario Agreement. These studies should result in the upgrading of the treatment facilities in the Lower Great Lakes Basin.

*Sludge disposal, *Anaerobic digestion, *Landfills, *Lagoons, *Canada, *Waste water treatment, Environmental effects, Phosphorus, Chemical precipitation, Great Lakes region, Treatment facilities

Agricultural land, Ontario, Canada-Ontario Agreement

D216
SLUDGE HANDLING AND DISPOSAL PRACTICES IN ENGLAND,

Webber, J.

Agricultural Development and Advisory Service, Leeds, England,
Ministry of Agriculture, Fisheries and Food

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 10-26. 11 tab, 12 ref.

In England and Wales approximately 94% of the population has sewers. Four-fifths of the sewage is treated at sewage plants and used for agricultural purposes or otherwise disposed of on land. The remaining one-fifth is disposed of at sea or in estuaries after some pre-treatment. For disposal at sea liquid sludge is taken out to deep water in specially designed barges where it is dumped. Studies of Liverpool Bay have shown no serious pollution but suggest that some accumulation of chemicals, pesticides, and metals might be harmful to marine life in the future. Sewage sludge has been used to reclaim the land at gravel pits and collieries with some success. Sewage farms near large centers of population are being used less frequently due to the value of the land for housing. Incineration and composting are other methods for sludge disposal that have been occasionally in use in England. Sewage sludge is also disposed of on agricultural lands where it is used as a source of nitrogen and phosphorus. Studies have shown that where sludges from industrial areas have been used there may be damage to crops from zinc and copper. When sludges include lead, cadmium, or mercury, there may also be a hazard to man and livestock consuming the crops.

*Sludge, *Sludge disposal, Land reclamation, Incineration, Bodies of water, Nitrogen, Phosphorus, Copper, Zinc, Lead, Cadmium, Mercury

England, Wales, Composting, Farmland

D217
USE OF SEWAGE SLUDGE IN AGRICULTURE WITH ADEQUATE ENVIRONMENTAL SAFEGUARDS,

Larson, W. E., Susag, R. H., Dowdy, C. E., Clapp, C. E., and Larson, R. E.

U. S. Department of Agriculture, St. Paul, Minnesota, Agricultural Research Service

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 27-45. 3 fig, 4 tab, 14 ref.

In the United States methods of handling and disposal of sewage sludge are being re-evaluated. The processing and disposal of sludge accounts for half of the cost of sewage treatment. In small communities disposal of sewage sludge by land spreading has been used for years. In larger communities dewatering followed by incineration has been used to dispose of sludge. Stricter air pollution restrictions and increased costs are making incineration less desirable. New pollution regulations applied to landfills require improved dewatering techniques. The most desirable alternative is agricultural use of the sludge. The advantages of this method are increased crop yield and reclamation of land. An area of concern is that heavy metals from industrial wastes may seep into the soil, causing reduced soil productivity and increases of heavy metals in the human food chain. The problem that could arise is pollution of surface water from runoff. This could be controlled by proper management.

*United States, *Sludge disposal, *Sewage treatment, *Waste water treatment, Dewatering, Incineration, Land reclamation, Industrial wastes, Costs, Crop production, Food chains, Surface runoff, Farm management, Landfills

Pollution regulations, Agricultural land, Soil productivity

D218
AEROBIC AND ANAEROBIC SLUDGE DIGESTION,

Boyko, B. I.

Ontario Ministry of the Environment, Toronto, Canada, Pollution Control Branch

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 46-62. 3 fig.

The goal of water pollution control plants is to produce high quality effluents. This is achieved through the removal of organic pollutants, a process which produces quantities of sludge requiring pre-treatment before disposal. Digestion is the method by which these sludge solids are treated. Anaerobic digestion is a biochemical process taking place in the absence of oxygen through the action of enzymes and microorganisms. It is a two phase process consisting of an acid fermentation phase and a methane phase. Aerobic digestion is a biological process involving oxidation of bio-degradable matter by microorganisms and microbial cellular material by endogenous respiration. Both methods can be inhibited by toxic materials. When the two methods are compared for performance they should not be considered as equal alternatives for sludge treatment. The size and usage of the facility are among factors determining the choice of method to be applied.

*Anaerobic digestion, *Aerobic treatment, *Sludge treatment, *Waste water treatment, Enzymes, Microorganisms, Oxidation, Treatment facilities

Acid fermentation, Alkaline fermentation, Organic pollutants

D219
AGRICULTURAL USE OF SLUDGE,

Webber, L. R., and Hilliard, B. C.

Guelph University, Guelph, Canada, Department of Land
Resource Science

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 120-142. 6 fig, 5 tab, 12 ref.

The environmental impact of land disposal of wastes is discussed. For sludge disposal to agricultural lands, soil properties should be evaluated. Soils with a high water table are not suitable for waste disposal. Studies are being done on concentrations and movement of nitrogenous compounds in the soil, the distribution of phosphorus, and the assessment of cadmium in crops and soil. Nitrogen in sludge applied to agricultural land is useful as fertilizer and can increase crop yield. Phosphorus can also be useful for agriculture. Both of these elements are suspect in lake eutrophication, growth of algae, and water quality. Cadmium in certain quantities is toxic to man and animals; the absorption of cadmium by plants may relate to the zinc-cadmium ratio of the soil.

*Sludge, *Land, *Environmental effects, *Soil properties, Phosphorus, Nitrogen, Cadmium, Crops, Fertilizers, Algae, Lakes, Eutrophication, Water quality, Water table, Toxicity

Zinc-cadmium ratio

D220
PROPOSED STANDARDS: LAND DISPOSAL OF EFFLUENTS,

Betz, J. V.

South Florida University,
Tampa, Florida,
Department of Biology

Civil Engineering, ASCE, Vol. 45, No. 5, p 77-79, May, 1975.

Advantages and areas of concern for land disposal of effluents are discussed. When proper pre-treatment is given to sewage effluent, thus eliminating nitrates, toxic metals, detergents, and pathogenic bacteria, the resulting effluent may be used to irrigate the soil and crops. Purification then takes place, encompassing: nutrient uptake capacity of vegetative cover; biochemical reactions caused by microorganisms in the soil; inorganic chemical absorption to some extent by non-living soil constituents; and, mechanical filtering effects of passing through the soil. Advantages of this type of land disposal include: pollutants being kept from surface waters; sewage water providing crop and vegetation fertilizer; nutrients being recycled back into the soil and water being recharged back into the ground. In addition, the process is more economical than advanced waste treatment. However, the quality of groundwater is threatened when land disposal is not properly regulated or enforced. Examples occur if: septic tanks are not properly installed and permit aquifer contamination; sewage sludge disposed of in landfills is not monitored; drainage wells dispose of unwanted stormwater from farmlands, streets, and polluted lakes, as well as some sewage plants; open dump leachate seep into groundwater; canals and flood control channels cut into underlying aquifers and permit salty or polluted water to contaminate groundwater; or if sewage treatment plant effluents are disposed of in lagoons, percolation, or evaporation ponds, and then seep underground.

*Waste water treatment, *Waste disposal, Effluents, Pre-treatment, Land management, Sewage treatment, Economics, Groundwater, Water quality

D221
GREEN SYSTEMS FOR WASTEWATER TREATMENT,

Environmental Science and Technology, Vol. 9, No. 5, p 408-409, May, 1975. 1 fig, 1 tab.

Biological techniques may be successfully applied to the treatment of water and waste water. Such methods were described at the International Conference on Biological Water Quality Improvement Alternatives, held this spring at the University of Pennsylvania in Philadelphia. Traditional water treatment is achieved on a household scale in the Sudan where water from the Blue Nile is flocculated and clarified in a 20 liter jar with pounded seeds of the tree Moringa olifera. At the Krefeld water treatment facility in West Germany, polluted Rhine river water is given secondary treatment (following primary treatment) by pumping the water through reeds to precipitate solids; sludge is then aerated and sprayed into a lagoon containing bulrushes. These bulrushes neutralize extreme pH values, reduce COD, and increase DO. Tertiary treatment may then follow by filtration through natural sand and gravel. In Holland, a similar reed-bulrush-polypropylene fiber system was developed. At Penn State University, waste water reuse with spray irrigation of treated municipal sewage effluent to a mixed hardwood forest has been practiced for twelve years. Called "the living filter concept", this sytem is recommended as efficient and economical for small cities and suburbs with available land. At Woods Hole, Massachusetts, marine aquiculture systems are being considered for removal of nutrient-rich wastes, and perhaps to provide a new commercial crop. Other biological techniques suggested include the use of biological "filters", such as fresh water plants, invertebrates, and fish to control influent pH, and to improve organic, mineral, and bacteriological water quality.

*Waste water treatment, *Water treatment, Aquiculture, Treatment facilities, Precipitation (chemical), Spraying, Irrigation, Water reuse, Nutrient removal, Water quality control

*"Living filter" concept, Biological systems, Secondary treatment, Rhine River, Blue Nile River, Spray irrigation

D222
STUDIES OF THE BIOCHEMICAL FACTORS CONTROLLING THE FLOCCULATION OF ACTIVATED SLUDGE,

Magara, Y., and Nanbu, Y.

Gesuido Kyokaishi, Vol. 11, No. 126, p 5-11, 1974. 20 ref.

Flocculation and sedimentation of activated sludge in sewage water treatment were studied in relation to poly-beta-hydroxybutyric acid (PHB) produced within cellular parts of microorganisms in the activated sludge particles, organic matter produced at external cellular parts (ECP), and the electrophoresis value of solution. Three different types of the Pasveer's artificial sewage water were used. These were 0.135, 0.350, and 0.750 kg BOD/kg MLSS day. Both PHB and ECP levels decreased with increased average TOC staying time, and the absolute electrophoresis value of solution increased with the decreased PHB and ECP levels. Since the ECP are considered to have a carbonyl group, the sludge particles have negative charges and the electrical repulsive force between particles increases with higher ECP level, causing lowered flocculation and sedimentation. Thus the ECP was thought to be the main factor responsible for the efficiency of flocculation. Flocculation and sedimentation become poorer with higher concentrations of organic matter in the sewage water. This is explained from the fact that the average TOC staying time decreases since the average sludge staying time shortens with more organic matter per unit weight of activated sludge.

*Activated sludge, *Flocculation, *Sewage treatment, *Waste water treatment, Sedimentation, Organic matter, Efficiencies

External cellular parts (ECP), Poly-beta-hydroxybutyric acid

D223
FINAL DISPOSAL OF MUNICIPAL SLUDGE IN SWEDEN,

Tullander, V.

Microbiological Division, Research Laboratory,
National Swedish Environmental Protection Board,
Drottningholm, Sweden

Journal of the Water Pollution Control Federation, Vol. 47, No. 4, p 688-695, April, 1975. 2 fig, 1 tab, 1 ref.

A summary is presented of the most recent legislation from the National Swedish Environmental Protection Board on final disposal of municipal sludge in that country. The responsibility for municipal sludge disposal is seen as resting with the individual waste water treatment plant manager. Sludge handling for final disposal is dependent upon the sludge quality, preliminary treatment, and available local disposal methods. The types of disposal recommended are deposition either at sludge disposal sites or at landfill, or deposition for soil enrichment and agricultural use. Methods such as drying, incineration, or composting, are considered to be intermediate rather than ultimate disposal steps. Choice of storage site should be based on the assessment of ground conditions. Factors to be considered in developing a disposal system include the diversion of rain and surface water, the building of dike walls around the disposal site, the collection and disposal of sludge runoff, and the continued inspection of sites, with appropriate safety measures to be taken. Sludge for agricultural use may require a short term, intermediate storage site, which should be located where no leaching and subsequent pollution of local water supplies might occur. Digested sludge as a fertilizer must meet Swedish standards such as metal content and must be continuously controlled as to effluent quality and frequency of application.

*Legislation, *Ultimate disposal, Municipal wastes, Waste disposal, Treatment facilities, Waste water treatment, Sludge disposal, Landfills, Storage, Fertilizers

*Sweden, *Sludge handling, Agricultural disposal

D224
THE PHYSICO-CHEMICAL TREATMENT OF CRUDE SEWAGE,

McKendrick, J., and Swart, E. R.

Water Pollution Control, Vol. 74, No. 2, p 155-159, 1975. 4 tab, 6 ref.

A pilot plant for physico-chemical treatment of crude sewage is being planned in Rhodesia. This process is designed to overcome some of the problems of the land irrigation of final effluents, especially for this type of area which has seasonal rainfall, and relies on storage dams for adequate water supply. In addition, physico-chemical processes can be more immediately corrected for changes in sewage quality than can biological ones. The proposed method consists of flocculation of raw sewage with alum, clarification, sand filtration, and activated carbon treatment. Ammonia and total nitrogen removal from the activated carbon effluent presents the greatest problem. Laboratory trials resulted in 99.7% ammonia removal with the use of the naturally occurring zeolite clinoptilolite. This level is well below Rhodesian Water Pollution Regulations, but use of this treatment depends upon whether natural clinoptilolite can be found in Rhodesia or whether a resin with similar characteristics can be economically synthesized.

*Pilot plants, *Waste water treatment, *Sewage treatment, Activated carbon, Alum, Clarification, Filtration, Ammonium

*Physico-chemical treatment, Crude sewage, Nitrogen removal, Zeolites, Clinoptilolite, Rhodesia

D225
AMMONIA REMOVAL FROM MUNICIPAL WASTEWATERS BY ION EXCHANGE,

Koon, J. H., and Kaufman, W. J.

Associated Water and Air Resources Engineers, Incorporated, Nashville, Tennessee

Journal of the Water Pollution Control Federation, Vol. 47, No. 3, p 448-465, March, 1975. 14 fig, 9 tab, 23 ref.

The conditions under which the zeolite ion exchanger clinoptilolite is most effective and economical for ammonia removal from waste waters were investigated. Experimental results were cited for defining optimum operating parameters for clinoptilolite exchangers and for estimating the cost of ammonia removal with clinoptilolite. It was found that the ammonium exchange capacity of clinoptilolite in domestic waste water treatment may be estimated from the cationic strength of the column influent. While total ammonium exchange capacity for Na- and Ca-clinoptilolite were identical, breakthrough capacity was more than two times as great for Na-clinoptilolite, probably because of the greater mobility of the smaller sodium ion in the zeolite pores. The total cost for ammonium removal with clinoptilolite for a 10 mgd plant was estimated to be $0.101 per 1000 gallons when regenerant is reused and $0.163 per 1000 gallons when regenerant is used only once.

*Ion exchange, Economics, Ammonium, Waste water, Municipal wastes, Costs

*Zeolites, *Clinoptilolite

D226
CENTRIFUGES - TYPES AND APPLICATIONS,

Keith, F. W., Jr.

Pennwalt Corporation, Warminster, Pennsylvania, Sharples-Stokes Division

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 351-368. 10 fig.

Three types of centrifuges are currently being used in municipal and industrial waste treatment plants for thickening or dewatering. The scroll type centrifuge is the most commonly used type. Because of its design it can be used for almost all sludges containing primary solids as well as for those with lime added for phosphorus removal. In order to handle soft secondary sludges a polymer must be added. The imperforate bowl knifing centrifuge has been successful with biological sludges and handles alum sludges readily. Their main advantage is that they can give a recovery of 90-95% and do not need a polymer. The disc centrifuge is used for the thickening of clean secondary activated sludge. It has had recovery rates of 85-90% without using a polymer. The three types of centrifuges may be used separately or in combination.

*Treatment facilities, *Sludge, Polymers, Centrifugation, Waste water treatment, Equipment, Industrial wastes, Municipal wastes, Sludge treatment, Thickening, Dewatering

*Centrifuges, Disc centrifuge, Scroll centrifuge, Imperforate bowl knifing centrifuge

D227
THE USE OF PHYSIOCHEMICAL SLUDGE CHARACTERISTICS AND BENCH DEWATERING TESTS IN PREDICTING THE EFFICIENCY OF THICKENING AND DEWATERING PROCESSES,

Stickney, R., and LeClair, B. P.

Environment Canada, Ottawa, Wastewater Technology Centre, Environmental Protection Service

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 315-350. 9 fig, 11 tab, 12 ref.

The Canada-Ontario Agreement on Great Lakes Water Quality of 1971 specifies that the levels of nitrogen, carbon, and phosphorus considered essential for the growth of algae be drastically reduced in waste treatment plant effluents. Conventional treatment methods used to remove these nutrients may cause sludge characteristics that can result in disposal and dewatering problems and will increase sludge production. Provisions have been made in the agreement for research programs to study these problems. Runs at the Wastewater Technology Centre's pilot plant provided data on sludge production and properties. It was found that sludge production and characteristics were altered by adding phosphorus removing chemicals. These chemical additions resulted in an increase in total solids production and sludge volume and had a harmful effect on dewatering characteristics. In most cases the introduction of chemical treatment will result in the present sludge handling facilities having to be increased. Lime treatment is the notable exception. The improvement in dewatering was such that the handling facilities could be reduced even though the sludge solids increased.

*Treatment facilities, *Sludge treatment, Effluents, Nitrogen, Carbon, Phosphorus, Algae, Dewatering

Canada-Ontario Agreement on Great Lakes Water Quality, Phosphorus removal, Lime treatment

D228
EFFECTS OF CONTROL VARIABLES AND SLUDGE CHARACTERISTICS ON THE PERFORMANCE OF DEWATERING AND THICKENING DEVICES,

Campbell, H., and LeClair, B. P.

Environment Canada, Ottawa, Wastewater Technology Centre, Environmental Protection Service

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 280-314. 13 fig, 2 tab, 10 ref.

The Canada-Ontario Agreement on Great Lakes Water Quality of August 1971 insures the restoration and protection of the Great Lakes water quality. A drastic reduction of nitrogen, carbon, and phosphorus in waste treatment plant effluents is specified in the agreement. A program was set up by the Wastewater Technology Centre to measure sludge production, characterize the physical and chemical properties of sludges, and correlate these properties with various sludge dewatering processes. The equipment used included mobile pilot-scale dewatering units and a mobile bench-pilot scale sludge dewatering facility. Various centrifuges and filters as well as an air flotation unit and gravity thickener were also used. Sludges were taken from the Centre's extended aeration pilot plant and activated sludge plants at two locations in Ontario. A polymer was used in the separation process in the centrifuges. In the solid bowl centrifuge the polymer dosage was an important adjustable control variable. For all sludges, 99% solids recoveries were possible. The cake solids were not as susceptible to control variables as solids recovery. In the basket centrifuge, polymer addition was necessary to produce a high recovery degree when digested alum sludge was used, while for waste activated sludge recovery in excess of 90% was possible without the addition of a polymer. Centrifugation gave the greatest degree of thickening but for clarification of waste activated sludge, air flotation was superior.

*Treatment facilities, *Waste water treatment, *Water quality, Sludge, Dewatering, Great Lakes, Pilot plants, Effluents, Centrifugation, Polymers, Nitrogen, Carbon,

D229
PACKAGE PLANTS: THE CONTRACTOR'S POINT OF VIEW,

Choritz, E. L.

Water Pollution Control, Vol. 74, No. 2, p 201-203, 1975.

Package type sewage plants are discussed from the point of view of the contractor. Advantages to the contractor of such plants are that a discrete range of standard products can be offered, eliminating design, administrative, and after sales costs; overall plant responsibility minimizes possible controversy over process malfunction or failure; and plant complexity is reduced, plant compactness increased, and costs decreased without affecting plant performance. The disadvantages of package plants for the contractor include: a lack of flexibility in choice of size range; absence of adaptability; and difficulty for a prospective client to assess and judge the variety of types of packages offered by different contractors. When a client approaches a contractor directly, he specifies a contributing population or a total daily flow; he also may specify the particular type of treatment to be employed. However, the plant design, size of equipment, and guarantee of performance and quality is up to the contractor. Package plants should not be specified where extreme variations in population (such as a temporary camping site) occur. It is expected that package sewage treatment plants will increase in use. Control and regulation of effluent discharges necessitates enlarging their field of application. Non-biological treatment processes in package plants are needed as are plants which will operate at peak efficiency regardless of the volume and load of the influent.

*Sewage treatment, *Administration, *Facilities, Waste water treatment, Equipment, Design, Effluents, Population

*Sewage treatment package plants

D230
EXPERIENCES OF THE RUHRVERBAND WITH THE TREATMENT OF SEWAGE SLUDGE (ERFAHRUNGEN DES RUHRVERBANDES BEI DER KLAERSCHLAMMBEHANDLUNG),

Imhoff, R.

Gas-und Wasserfach-Wasser/Abwasser, Vol. 116, No. 5, p 216-221, May, 1975. 5 fig, 3 tab, 6 ref.

Sewage sludges must be stabilized prior to their disposal. This can be achieved by rotting, aerobic stabilization, composting, or ashing. The Ruhrverband in the Federal Republic of Germany operates 115 small water purification plants; on the average only 33,000 residents are served per plant. For these systems, primarily digestion tanks are used. Nine plants with population equivalents of less than 10,000 are operated according to the activated sludge method with aerobic sludge stabilization. The first plant in that area using sludge ashing preceding dewatering was recently put into operation. It serves a population of 300,000. Since natural sludge disposal will increasingly become more difficult for larger plants serving a population of 300,000 to 500,000 four more sludge ashing plants will go into operation shortly. Since sludge incineration is two or three times as expensive as digestion tanks, incinerators for this purpose will be built only if no other method can be applied.

*Sewage treatment, *Sludge disposal, Waste treatment, Waste water treatment, Waste disposal, Facilities, Dewatering, Aerobic treatment, Sludge treatment, Activated sludge, Stabilization

Composting, Ashing, Germany

D231
PLANNING AND CONSTRUCTION OF SLUDGE TREATMENT PLANTS (PLANUNG UND BAU VON SCHLAMMBEHANDLUNGSANLAGEN),

Vater, W.

Technische Mitteilungen, Vol. 68, No. 5, p 181-185, May, 1975. 6 fig, 36 ref.

Treatment of sludge from communal waste water is planned to either convert the sludge into a useful form such as fertilizer or to complete hazard-free disposal. At the planning stage of such facilities the Federal Waste Disposal Act (Germany), the Water Act and the Technical Directives for the Conservation of Clean Air (TA-Luft) must be taken into consideration. The advice of specialists is recommended. Any recycling or disposal of the sewage sludges must be preceded by a stabilizing process such as aerobic, anaerobic, aerobic-thermophilic stabilization, or by pasteurization, irradiation, or composting. Existing sludge disposal methods including composting, thermal drying, and incineration are reviewed.

*Sludge treatment, *Waste disposal, Sludge disposal, Legislation, Waste water treatment, Water reuse, Incineration, Facilities, Stabilization, Construction, Planning

Germany, Composting

D232
COMPOSTING PLANT FOR REFUSE-SEWAGE SLUDGE IN THE DISTRICT OF GROSS-GERAU (MUELL-KLAERSCHLAMM-KOMPOSTIERUNGSANLAGE FUER DEN KREIS GROSS-GERAU),

Kurney, W.

Aufbereitungs-Technick, Vol. 16, No. 5, p 219-225, May, 1975. 7 fig, 2 ref.

A composting plant for a mixture of refuse and sewage was designed. The facility is automated and incorporates transport systems which meet environmental protection requirements. Biological treatment is accomplished with the vacuum-pressure impulse method. Material is heaped onto a rotating plate and a vacuum is produced in the groove so that air is drawn through the trash/sewage sludge mixture, yielding a high percentage of oxygen to the microorganisms. Odors are carried to a compost filter where odorous substances adhere to the filter material and are decomposed by microorganisms. Waste gases leaving the compost filter are free of unwanted odors. Through the supply of oxygen, mesophile and later thermophile bacteria develop, raising the temperature within three days to about 60 or 70 C. This temperature can be maintained through aeration until all organically decomposable substances are used up; end products are sifted and either used in agriculture or dumped.

*Sewage treatment, Waste treatment, Facilities, Biological treatment, Solid wastes, Microorganisms, Odors, Aeration, Organic compounds, Automation

Composting, Vacuum-pressure, Rotting process

D233
PASTEURIZATION OF SAPROPEL (PASTEURISIERUNG VON FAULSCHLAMM),

Soerensen, C. K.

Gas-und Wasserfach-Wasser/Abwasser, Vol. 116, No. 5, p 222-224, May, 1975. 1 fig, 2 tab, 2 ref.

Pasteurization experiments with sludge remaining from waste water purification were carried out in spiral heat exchangers. Pasteurization for five minutes at 80 C eliminated all salmonellae and the indicator bacterium Escherichia coli. A determination of the total germ number at 37 C under aerobic and anaerobic conditions revealed no relationship between the intensity of the pasteurization effect and the pasteurization temperature. This may be explained by the varying content of bacterial spores in the digested sludge. In the experiments, a reduction in the germ number from 65 to 85 percent has been achieved. The increase of the COD in the sludge water doubled at pasteurization between 75 and 85 C and rose to nine-fold at pasteurization temperatures between 90 and 95 C. The steam consumption of the experiments was 47 kg steam/cu m sludge at a throughput of 15 cu m sludge/hr.

*Sludge treatment, *Waste water treatment, Aerobic treatment, Anaerobic treatment, Chemical oxygen demand, Bacteria

*Pasteurization, *Sapropel

D234
THE EFFECT OF TEMPERATURE ON THE AEROBIC DIGESTION OF WASTE-WATER SLUDGE,

LePage, L. R.

New Hampshire University,
Durham, New Hampshire,
Department of Civil Engineering

OWRR Research Report A-030-NH (1), 1974. 81 p, 18 fig, 41 ref.

Small-scale laboratory experiments were performed on an undiluted primary waste water sludge to determine the effects of temperature on the aerobic digestion process. Conclusions of the study include: greater reduction in BOD, COD, total solids, and total volatile solids occur at higher temperatures; digestion for periods longer than 15 days produced only a small improvement in the degree of stabilization; the effect of temperature on the degree of stabilization was more significant at shorter detention times; no correlation was found between temperature and settleability of the sludge; the settleability of treated sludge was less than that of the raw feed sludge; higher temperatures of digestion resulted in improved filterability of the treated sludge; after 15 days digestion at higher temperatures, the filterability of the treated sludge sharply dropped; filterability of digested sludge was not as good as the filterability of the raw sludge; aerobically digested sludge had no disagreeable odor either during aeration or filtration; at 5 C, a longer detention time is required to reach stabilization and to improve the characteristics of the digested sludge than at higher temperatures; and, the time and effort required to achieve the same degree of stabilization is much less with aerobically digested primary sludge than with anaerobically treated sludge.

*Sludge treatment, *Waste water treatment, *Temperature, Digestion, Aerobic conditions, Stabilization, Laboratory tests, Anaerobic digestion

D235
PACKAGE TREATMENT PLANTS AND FACTORS AFFECTING SERVICE,

Martin, P. H.

Northern Purification Services Limited,
North Vancouver, British Columbia, Canada

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, British Columbia, p 219-225.

Package plants of less than 20,000 gpd which use biological treatment methods are discussed. Package plants are usually chosen because of economics or unsuitability of the conventional septic system or the unavailability of a conventional municipal type of sewage collection service. Improvements in package plants over the last ten years have included: the use of non-corrosive long lived materials resulting in reduced preventative maintenance of the shell, extended life and guaranteeing a reuse factor for the product; concrete technology has produced concrete finishes that are essentially inert if properly applied; plastic piping, valving and fastenings have aided in minimizing corrosion and easing the disassembly and reassembly of components; control and fail safe systems are now available; processes to minimize the adverse effects of fluctuating organic and hydraulic loads have been refined; and, plant design has become more aesthetically pleasing. Package plants have clearly defined performance limits and cannot be expected to perform outside these limits. The performance of a package plant will be dependent on the quality of the engineering design. Regular trained service or preventative maintenance procedures are a necessity. The serviceman must be aware of the capabilities of the package plant and make sure that no abuses are present.

*Waste water treatment, *Sewage treatment, *Domestic wastes, Treatment facilities, Biological treatment, Design criteria, Corrosion control

*Package plants

D236
SPRAY IRRIGATION OF TREATED MUNICIPAL SEWAGE,

Oldham, W. K.

British Columbia University,
Vancouver, British Columbia, Canada,
Civil Engineering Department

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, British Columbia, p 227-239. 2 fig, 5 tab, 3 ref.

Research is described which was conducted to determine a water and nutrient budget for spray irrigation of secondary effluent from a municipal waste water treatment plant in the Okanagan Valley of British Columbia, Canada. The usefulness and acceptability of the forage crop produced was also considered. The long-term usefulness of such a disposal method at various rates of application was estimated. Conclusions reached include: the application rate (0.32 inches/day) used in irrigating the alfalfa was close to the optimum rate for water and macro-nutrient utilization; limiting the irrigation period to the alfalfa growing season will produce an ideal phosphorus balance; at the application rate used over the irrigation season, the annual phosphorus increase in the five-foot deep soil horizon amounts to an average of 0.7 ppm; other impurities were determined to be well absorbed by the soil and their rates of concentration increase much lower than that for phosphorus; the alfalfa crops grown compared well with similar crops grown using non-waste water irrigation water; and the amount of impurities released to the groundwater was found to be negligible.

*Waste water treatment, *Irrigation, *Waste water disposal, Water reuse, Groundwater, Nutrients, Phosphorus, Nitrogen, Agriculture, Crop response

Alfalfa

D237
NITROGEN REMOVAL FROM MUNICIPAL WASTEWATER,

Climenhage, D. C.

Environment Canada Research Report No. 17, 33 p, 6 fig, 5 tab, 29 ref.

A biological treatment process has been developed to remove nitrogen from industrial waste water. The denitrification stage is first, followed by an extended aeration stage that effects BOD reduction and nitrification. Mixed liquor from the aerated stage is recycled at a high rate to the anaerobic stage where nitrate is denitrified using the sewage as the organic carbon source. The advantage of this process is that the need for carbon addition to the denitrification stage is eliminated. A pilot plant study was performed to test the effectiveness of this process on municipal waste water. The domestic waste water that was to be used as the test substrate had a very low BOD and was therefore mixed with hexamethylene diamine and methanol to raise the BOD and organic nitrogen concentration. An overall nitrogen removal efficiency of 85-90% was achieved on a mixture of 25% sewage and 75% chemical additives. The efficiences were based on total nitrogen in the influent and filtered effluent and were achieved with recycle to feed ratios of 1:1 to 1.5:1. About 18% of the nitrogen removal was accounted for by recycle to the anaerobic first stage and about 13% was accounted for by cell synthesis. Further experimentation is recommended to confirm the results of this test using full strength sewage without chemical additives, and to investigate the mechanism of nitrogen removal and the effect of important parameters on nitrogen removal efficiency.

*Waste water treatment, *Biological treatment, *Denitrification, Nitrification, Sewage treatment, Nitrogen cycle, Pilot plants, Biochemical oxygen demand

D238
RECYCLING OF INCINERATOR ASH,

Diosady, L. L.

Environment Canada Research Report No. 19. 82 p, 13 fig, 14 tab, 37 ref, 1 append.

A preliminary study was performed on the feasibility of iron, aluminum, heavy metals, and phosphorus recovery from incinerated sewage sludge ash. The project included a literature review; examination of ash composition, solubility of ash components, and separation techniques; and an economic evaluation of separation methods and an estimation of the equipment needed for a pilot plant. Aluminum and iron recovery was found to be uneconomical. Aluminum was present in the ash in the form of a refractory oxide that is not amenable to any inexpensive chemical treatment. The ash was highly varied in composition. Approximately 50% of the ash was in the chemically inert form of silicates and alumina. A large proportion of all heavy metals, especially zinc and chromium, was physically or chemically bound by these refractories, which are not available through acid digestion. The simplest approach to safe ash disposal may be to form refractories from all ash components. By adding fluxing agents, or by altering the incinerator conditions, it may be possible to produce a glasslike ash that will contain much lower quantities of leachable heavy metals than the present ash. Phosphorus, present to the extent of 14-18% expressed as phosphoric acid, has the highest economic value in the ash. It may be recovered by the use of phosphoric or 60% sulfuric acids.

*Sludge treatment, *Incineration, *Phosphorus, *Heavy metals, Separation techniques, Iron, Aluminum, Pilot plants, Ultimate disposal

D239
DISPOSAL OF CHEMICAL SEWAGE SLUDGES ON LAND AND THEIR EFFECTS ON PLANTS, LEACHATE AND SOIL SYSTEMS,

Chawla, V. K., Bryant, D. N., and Liu, D.

Environment Canada, Ottawa, Canada, Wastewater Technology Centre, Environmental Protection Service

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 207-233. 8 fig, 11 tab, 14 ref.

In 1972 an extensive lysimeter study was undertaken at the Wastewater Technology Centre, Burlington, Ontario, to determine the long-term environmental effects of chemical sewage sludges disposed of on land. The soils used in the study were silt loam and loamy sand. The sludges applied were anaerobic digested lime treated sludge, alum treated sludge, and ferric chloride treated sludge. A commercial fertilizer was also used. Plants and leachates were collected and analyzed. The study yielded the following conclusions: the rate of sludge application determined the yield of dry matter; with a high rate of iron and lime sludges on loamy sand, the yields were comparable to fertilizer; and on silt loam the yields were higher than with the fertilizer addition. On both soils, alum sludge gave lower yields than iron sludge, lime sludge, or fertilizer. Plant growth retardation could occur from the low potassium, high zinc and aluminum content of the alum sludge. High concentrations of petroleum hydrocarbons in the alum sludge also caused some plant toxicity. The nitrogen, phosphorus, potassium, nickel, copper, and zinc concentrations in the plants related to the amount of sludge applied. The nitrogen level in the leachate did not pose a potential hazard to groundwater. During the one-year study period no apparent chemical changes in the soil were observed.

*Sewage sludge, *Environmental effects, Land, Soils, Fertilizers, Plant growth, Leachate, Nitrogen, Phosphorus, Potassium, Nickel, Copper, Zinc, Aluminum, Groundwater

Waste Water Treatment Centre (Burlington, Ontario), Sludge-soil-plant system

D240
AEROBIC DIGESTION OF WASTEWATER SLUDGE UNDER LOW TEMPERATURE CONDITIONS,

Bishop, P. L., and LePage, L. R.

New Hampshire University,
Durham, New Hampshire,
Department of Civil Engineering

OWRR Research Report A-037-NH (1), March, 1974. 17 p, 6 fig, 1 tab, 12 ref.

The feasibility of winter operation of aerobic digesters in New Hampshire and other northern areas was examined. Small-scale laboratory experiments were conducted using continuous aeration, intermittent mechanical mixing, and a batch draw and fill operation, at six different temperatures ranging from 5 to 30 C. Conclusions drawn include: greater reductions in BOD, COD, Total solids and Total volatile solids occur at higher temperatures; digestion for periods longer than 15 days achieved only minimal improvement in stabilization except at temperatures below 5 C; the effect of temperature on the degree of stabilization was more significant at shorter detention times; no correlation was found between temperature and settleability of sludge; the settleability of treated sludge was less than that of raw sludge; higher temperatures of digestion improved the filterability of the treated sludge; filterability was decreased after 15 days digestion at higher temperatures; the filterability of digested sludge was not as good as that of the raw sludge; and, no disagreeable odor of the aerobically digested sludge was found during aeration or filtration.

*Aerobic treatment, Digestion, Sludge treatment, Temperature, Laboratory tests, Odor, Stabilization

*Aerobic digestion, Settleability

D241
THERMOPHILIC DIGESTION AT THE HYPERION TREATMENT PLANT,

Garber, W. F., Ohara, G. T., Colbaugh, J. E., and Raksit, S. K.

Los Angeles Hyperion Treatment Plant,
Playa del Rey, California

Journal of the Water Pollution Control Federation, Vol. 47, No. 5, p 951-961, May, 1975. 6 fig, 5 tab, 10 ref.

The Hyperion Treatment Plant, Playa del Rey, California, used full-scale thermophilic digestion (thermophilic temperatures, 46-54.5 C) from 1953 to 1957. Thermophilic digestion is again being instituted at the plant in an attempt to achieve total removal of digested-screened solids prior to ocean disposal of the treated waste water. In addition to confirming earlier conclusions about thermophilic anaerobic digestion, the dewaterability of thermophilic sludge through the use of various types of chemical conditioning and dewatering apparatus is being examined. Thermophilic anaerobic digestion of waste water solids has been shown to be a successful process. Temperature change has been found to be more critical than with mesophilic digestion. The solids dewatering step is significantly improved by thermophilic digestion. The solids particle sizes are larger, lower amounts of chemicals are needed, drier cakes are obtained, and centrate-filtrates carry substantially fewer solids. The work at the Hyperion plant is still incomplete; the upper limits of loading are not yet established. At the currently possible temperature and loadings, the changes in gas production and solids breakdown do not overcome the added environmental and monetary costs of the extra heat energy needed if the change in sludge dewatering is ignored. The net benefit of thermophilic digestion seems to be greater than the costs resulting from the increased heat requirement.

*Waste water treatment, *Sludge treatment, *Anaerobic digestion *Temperature, Heat, Energy, Costs, Organic loading, Dewatering

*Thermophilic digestion

D242
METAL REMOVAL BY PHYSICAL AND CHEMICAL TREATMENT PROCESSES,

Maruyama, T., Hannah, S. A., and Cohen, J. M.

National Environmental Research Center,
Cincinnati, Ohio,
Advanced Waste Treatment Research Laboratory

Journal of the Water Pollution Control Federation, Vol. 47, No. 5, p 962-975, May, 1975. 13 fig, 11 tab, 47 ref.

Physical-chemical processes for the removal of heavy metals from raw municipal waste water involving chemical coagulation, granular media filtration, and granular activated carbon were investigated. Three different chemical coagulant schemes were tested: ferric sulfate, lime, and a combination of ferric sulfate and lime. Manganese was effectively precipitated by lime, poor removals were effected with iron as the coagulant. Cadmium removal by all three processes was high. The preferred method of nickel removal is lime treatment followed by activated carbon. The best removal of zinc was accomplished by iron coagulation followed by activated carbon. Iron coagulation was found to be the best process for copper removal. The highest removal of barium was obtained with the lime-ferric sulfate combination. Good removals of lead were obtained with all three processes. Cr^{3+} was effectively removed by all systems, however, Cr^{6+} was only effectively removed after activated carbon treatment. Ferric sulfate coagulation is the preferred method of arsenic removal. The removal mechanisms for the metals under investigation were discussed. It was determined that no one coagulation system produced the best removals for all metal forms; the chemistries of the metals and the coagulants must be considered in selecting the particular system to be used.

*Chemical precipitation, *Waste water treatment, *Heavy metals, *Activated carbon, Coagulation, Municipal wastes, Lime, Iron, Manganese, Cadmium, Nickel, Zinc, Copper, Lead, Chromium

D243
A DESIGN AND ECONOMIC EVALUATION OF WET-AIR AND CATALYTIC OXIDATION OF SEWAGE SLUDGE,

Fishbeck, A. G.

Delaware University,
Newark, Delaware,
Department of Chemical Engineering

OWRR Research Report A-014-DEL (9), 1974. 47 p, 16 fig, 6 tab, 19 ref, 1 append.

A modification of the wet air oxidation process developed by Zimpro Incorporated is proposed. The wet air oxidation reactor is redesigned to solubilize 99% of the organic solids at a lower pressure and temperature. The resulting organic rich solution will then be passed through a heterogeneous catalytic reactor in which the organic compounds will be completely oxidized. The experimental determination of solubilization kinetics for sludge solids was performed using yeast as the sludge model because of its similarity to sludge and ease of handling. The solubilization of yeast was found to involve both rapid oxidation and slower hydrolysis reactions which followed first order kinetics in solids concentration. The rate became oxygen mass-transfer limited after the oxygen initially dissolved in the solution was consumed. The wet air catalytic oxidation process was found to be economically similar to a typical wet air oxidation process, $4.10/ton solids processed and $3.87/ton, respectively. The wet air catalytic process achieves 99% removal of total organic carbon while the wet air oxidation process achieves only 60-70% removal and requires more severe conditions. The final products of a wet air catalytic oxidation of sludge are sanitary, easily disposed of, do not require recycle, and are essentially pollution free. It is recommended that future experiments in solubilization kinetics should be performed using activated sludge instead of yeast as the solid.

*Sludge treatment, *Sludge disposal, Activated sludge, Organic wastes, Yeast, Kinetics, Costs, Oxidation

*Wet air catalytic oxidation, Solubilization kinetics

D244
DOMESTIC SEWAGE TREATMENT BY UNDERDRAINED FILTER SYSTEMS,

Chawdhry, N. A.

Applied Sciences Section, Pollution Control Planning Branch, Publication No. 53, December, 1974. 93 p, 37 tab, 11 ref, 3 append.

Tests conducted for 3 1/2 years demonstrated the effectiveness of underdrained sand filters as alternatives to conventional tile fields for treating septic tank effluent. The commonly available sands from gravel pits used as the filter media ranged from 0.15 mm to 2.50 mm effective size and 1.0 to 4.5 uniformity coefficient. The filter beds produced effluents with BOD5 equal to or less than 7.8 mg/liter and suspended solids equal to or less than 4.6 mg/liter. The efficiency of treatment was 96.5%. Phosphorus removal by the filter media without chemical additives was 26.3-36.2%. The filter bed containing red mud, a by-product of Bauxite purification containing oxides of calcium, aluminum, and iron, removed 72.5-88.9% of the phosphorus. A period of six months was required for the establishment of the stabilization of nitrogenous compounds and the satisfactory reduction in free ammonia. Fecal coliforms were not totally removed but were considerably reduced when compared to septic tank effluent.

*Waste water treatment, *Filtration, *Septic tanks, Tile drains, Phosphorus, Ammonia, Biochemical oxygen demand, Suspended solids, Coliforms

Underdrained sand filters, Red mud

D245
SLUDGE HANDLING AND DISPOSAL SEMINAR,

Ontario Ministry of the Environment, Toronto, Ontario, Canada. 465 p.

The Proceedings of the Sludge Handling and Disposal Seminar held in Toronto, Ontario, Canada, September 18-19, 1974, contains 28 papers, mostly by Canadian authors. The subjects covered by the seminar included disposal of sludge on agricultural land with relation to crop utilization of nutrients in the sludge, land reclamation, regulatory aspects, microbiological aspects, and the potential environmental hazards of this practice. The seminar also covered sludge handling with regard to centrifugation, dewatering, filtration, incineration, metal recovery or removal, phosphate removal, pumping and hauling. Slduge handling and disposal practices in a regional municipality and a metropolitan area were also discussed.

*Conferences, *Sludge disposal, Land, Crops, Nutrients, Legal aspects, Microbiology, Environmental effects, Centrifugation, Dewatering, Filtration, Incineration, Pumping, Cities, Treatment facilities, Waste water treatment

*Sludge handling, Metal recovery, Metal removal, Phosphate removal, Hauling

D246
SLUDGE DEWATERING USING THE KRUGER CENTRIFUGE,

Roe, L. P.

The East Asiatic Company, Limited,
Canada

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 369-384. 1 fig.

The use of solid bowl decanter centrifuges for dewatering sewage sludges is now becoming common in Canada. The decanter centrifuge advantages are that it requires little operator attention and operates continuously. Its disadvantages are wear on the solids conveying scroll by the abrasive action of grit in the sludge and poor solids capture. Work has been done to overcome these disadvantages. Design improvements were made and the use in recent years of synthetic polymer flocculant aids have improved the solids capture. By lowering the g-force and scroll differential speed and by using an efficient degritting system abrasive wear can be lowered. Sludge dewatering investigations have been carried out at various treatment plants in Canada using the improved centrifuge. Performance varied according to the type of sludge. The decanter centrifuge is relatively easy to maintain, having only two major moving parts; the scroll and the bowl with the solid conveying scroll require the most maintenance. To shorten the downtime, it would be advantageous to have a spare scroll available.

*Dewatering, *Sewage sludge, Canada, Polymers, Equipment, Centrifugation, Waste water treatment, Operation

Centrifuges

D247
VACUUM DEWATERING OF SEWAGE SLUDGE,

Kemp, G. D.

Komline-Sanderson Limited

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 385-390. 2 fig, 1 tab.

Vacuum filters are being used at plants in Ontario to dewater raw sludge conditioned with polyelectrolytes or ferric chloride and lime, and in one case thickened waste activated sludge conditioned with a polyelectrolyte. The filter media used in many of the filters in Ontario are stainless steel springs. Fabric is the other filter medium used. The purpose of a vacuum filter is to achieve the dryest filter cake using the least amount of coagulant at the highest drum speed. Tests can be made to determine the proper amount of coagulant needed. Alum, lime, or ferric chloride are being used for reduction of nutrients at most of the plants using vacuum filters. Alum has had some effect on the amount of filter yield while lime and ferric chloride have not.

*Filters, *Dewatering, *Sludge, Lime, Polyelectrolytes, Waste water treatment, Sludge treatment, Activated sludge

Vacuum filters, Ontario, Ferric chloride, Alum

D248
ASPECTS OF INCINERATING CHEMICAL STUDIES,

Shannon, E. E., Plummer, D., and Fowlie, P. J. A.

Environment Canada, Ottawa, Wastewater Technology Centre,
Environmental Protection Service

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 391-412. 8 fig, 7 tab, 15 ref.

Incineration has been used as one of the cheapest methods of sludge disposal by large municipalities. The three types of incinerators used are the multiple hearth furnace which is the most common method of incinerating sewage sludges in North America and Europe, the fluidized bed furnace, and the rotary kiln furnace which has not been extensively used although it has the potential for handling thickened sludge directly. In incineration systems the most critical pretreatment step is sludge dewatering. In view of the potential problems involved in the incineration of phosphorus removal sludges the Environmental Protection Service at the Wastewater Technology Centre began a sludge incineration and precipitant recovery program. The preliminary results of the program showed that the calorific values of the chemical sludges varied with the type of sludge tested. The lime sludge did not present any problems but with the alum and iron sludges there is the possibility of clinker build-up. It is possible to recover iron and other heavy metals from incinerator ash.

*Incineration, *Sludge disposal, Waste disposal, Municipal wastes, North America, Europe, Dewatering, Sludges

Furnaces, Environmental Protection Service (Canada), Wastewater Technology Centre

D249
REMOVAL OF PHOSPHATES AND METALS FROM SEWAGE SLUDGES,

Scott, D. S., and Horlings, H.

Waterloo University, Waterloo, Ontario, Canada, Department of Chemical Engineering

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 413-443. 5 fig, 7 tab, 6 ref.

Now that waste water treatment plants are using chemical treatment for the removal of phosphates the sludges produced will not only contain phosphate but metals such as iron and aluminum used as coagulants or in the removal process. The sludges will also contain the phosphorus and metals that entered the plant. The removal of phosphates and metals from sewage sludges has become important particularly when they are used on agricultural lands. Experimental work has been done on the extraction and precipitation of metals from filter cake. It was found that the metals and phosphorus could be extracted by acid from either unconditioned or conditioned final anaerobic digested sludges. The control of the pH was important in the production of solid products containing iron and aluminum in one case and heavy metals in the other. Iron, aluminum, zinc, and phosphate can be recovered by further treating the solid products by conventional means.

*Waste water treatment, *Treatment facilities, Nutrient removal, Sludge, Iron, Aluminum, Zinc, Phosphates, Phosphorus, Heavy metals, Filters, Extraction, Precipitation (chemical)

Agricultural land, Phosphate removal, Experimental work, Chemical treatment

D250
SLUDGE HANDLING AND DISPOSAL PRACTICES IN THE REGIONAL MUNICIPALITY OF NIAGARA,

Simonen, E. R.

Regional Municipality of Niagara, Niagara, Canada, Public Works Department

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 444-451. 2 tab.

An act of the provincial government established the Regional Municipality of Niagara on January 1, 1970. The area is 719 square miles with a population of approximately 350,000. The region is comprised primarily of rural and agricultural land with about 70% of the population concentrated at St. Catharines, Niagara Falls, and Welland. At present the region has twelve sludge producing plants. This will be reduced to eight as new plants are completed. Anaerobic digestion is used except at the Crystal Bay, Chippawa, and Grimsby plants. Aerobic digestion is used at the Crystal Bay plant. The Chippawa plant will be phased out upon completion of the south side sewer scheme at which time its sludge will be treated at the Niagara Falls plant. An inoperative digester is being used as a holding tank for raw sludge at the Grimsby plant and the sludge treated at one of the larger plants. The digested sludge in the region is disposed of on land, offered to the public for use, or disposed of at landfills. The region has also been involved in research projects. One was testing various types of vehicles for spreading sludge on fields and investigating a spraying system. The other involved computer selection of various sludge disposal alternatives.

*Treatment facilities, Anaerobic digestion, Aerobic treatment, Sludge disposal, Research and development, Land, Landfills, Sludge treatment

Regional Municipality of Niagara (Canada)

D251
SLUDGE HANDLING AND DISPOSAL PRACTICES IN METROPOLITAN TORONTO,

Salib, W. A.

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 452-465. 1 fig, 2 tab.

In 1954 when Metropolitan Toronto was created there were 17 treatment plants operating in Toronto and its suburban municipalities with two plants under construction. A sewerage system plan put into effect in 1954 provided for trunk sewers to convey waste water to four major plants. By the 1960's the smaller plants had been taken out of service and the sludge disposal consolidated at the four treatment plants. All four plants process the sludge by anaerobic digestion followed by conditioning with polymers or ferric chloride and lime then centrifugation or vacuum filtration. The sludge is disposed of by hauling to landfill areas, incineration, or air drying storage and removal by the public for use as soil conditioners. Future plans for expansion of the main treatment plants are as follows: Highland Creek Treatment Plant will increase its capacity from its present 16 mgd to 64 mgd and the sludge processing by thermal processing, dewatering and incineration; Main Treatment Plant's capacity will be increased from 180 mgd to 300 mgd and the sludge processing by thermal processing, dewatering, and incineration; Humber Treatment Plant will increase from 62 mgd to 120 mgd with the sludge dewatered and hauled to the Main Treatment Plant for incineration; and modernization of the present facilities is under consideration for the North Toronto Treatment Plant.

*Treatment facilities, *Sewerage, *Sludge disposal, Anaerobic digestion, Polymers, Lime, Centrifugation, Filtration, Incineration, Landfills, Dewatering

*Metropolitan Toronto, (Canada), Thermal processing, Ferric chloride

D252
THE INFLUENCE OF PARTICLE SIZE ON OXIDATION OF TOTAL, SOLUBLE, AND PARTICULATE MUNICIPAL WASTEWATER COMPONENTS BY OZONE,

McCarthy, J. J.

Dissertation Abstracts International B., Vol. 35, No. 11, p 5461, 1975.

Experimental data using ozone as a waste water treatment oxidizing agent are presented. Municipal waste water containing varying sizes of solids was ozonated in a quiescent settling column and an ozone contact chamber. The effect of ozone oxidation on particular waste water parameters was measured from samples taken. Samples were then separated into their soluble and particulate fractions and the effects of ozone on each fraction was analyzed. Ozone tended to oxidize the particulate more than the soluble waste water fraction. The oxidation of the soluble waste water fraction is dependent upon the solids content of the waste water. With respect to waste water solids content and ozone consumption, the limitations of ozone in removing organic carbon, in acting as a disinfectant, and in satisfying oxygen demand were demonstrated. Solid particle size and distribution with increased settling time and ozone consumption were also discussed.

*Waste water treatment, *Ozone, *Oxidation, *Municipal wastes, Solids, Oxygen demand

Waste water fraction, Particulate matter

D253
DESIGN INFORMATION ON DEWATERING PROPERTIES OF WASTEWATER SLUDGES,

Farrell, J. B.

Environmental Protection Agency,
Cincinnati, Ohio,
National Environmental Research Center

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 269-279. 1 fig, 2 tab, 11 ref.

The Ultimate Disposal Section of the National Environmental Research Center, EPA, Cincinnati, Ohio, is working to make more information available on the handling of sludges produced by phosphate removal processes. To arrive at a minimum cost facility, it is necessary to "cost out" a number of potential process options in order to identify the more economical approaches. Cost estimates of the potential process options are important to the economical use of a waste water treatment facility. A large part of the plant cost is dewatering. Tables are presented whereby sludge yields can be estimated. The mass of chemical sludge produced when iron or aluminum salts are used has usually been estimated from simplified stoichiometric relationships, however, experimental data suggest that these estimates are low and should be increased by up to 35%. The mass of sludge produced by lime addition depends on the dose of lime required, the alkalinity of the waste water, and to a small degree on the phosphate content of the waste water. Calculated lime sludge doses should be increased by 20%. Field visits have also been made to plant sites with a sludge dewatering trailer. The site visits make it possible to: compare effectiveness of various dewatering devices for dewatering a given sludge; compare the performance of the dewatering equipment at the plant with the equipment in the trailer; and, observe at a number of sites how the performance of each device is affected by differences in sludge type and waste water source.

*Sludge treatment, *Dewatering, *Nutrient removal, Phosphorus, Lime, Aluminum, Iron, Equipment, Costs, Treatment facilities

D254
PHASE II GIVES HAMILTON SECONDARY TREATMENT,

Water and Pollution Control, Vol. 113, No. 6, p 14-16, June, 1975. 5 fig.

A secondary treatment phase was recently added to the municipal sewage treatment plant at the City of Hamilton, Ontario, Canada. The secondary treatment phase includes activated sludge treatment, pressure flotation for excess activated sludge thickening, additional digester, filter and boiler capacity, sludge incineration, stand-by power facilities, and landscaping. It also includes a 5000 IGPD pilot treatment plant which is being used to study the effects of biological treatment of various industrial wastes discharged to the sewer system, and for assessing the effectiveness of different nutrient removal processes. The methane gas generated in the digestion process is used as alternative fuel for the diesel generators during peak periods. The gas is also used as fuel for the sludge incinerators, to fire the steam boilers for heating the buildings, and for the digestion process. The plant has been essentially trouble free in operation and produces a high quality effluent. A quantitative description of some of the equipment is given as well as an outline of the treatment process.

*Waste water treatment, *Treatment facilities, *Municipal wastes, *Biological treatment, Activated sludge, Incineration, Methane, Fuels, Industrial wastes, Nutrient removal

Hamilton, Ontario, Canada, Secondary treatment

D255
IRON AND MANGANESE REMOVAL WITH OZONE,

Furgason, R. R., and Day, R. O.

Water and Sewage Works, Vol. 122, No. 6, p 42, 45-47, June, 1975. 2 fig.

A water treatment demonstration program performed in the Moscow, Idaho, municipal water system showed that ozone can be used to effectively and economically oxidize iron and manganese to an insoluble form that can be removed by filtration. The water supply of Moscow is supplemented at times of peak demand by several wells containing water with a high iron and manganese content. The high costs of developing new wells which would provide a higher quality water have prompted research into methods of iron and manganese removal. In addition to the tests on ozone treatment, ion exchange, sequestering, chemical oxidation and gravity filtration, chemical oxidation and pressure filtration, and contact filtration/manganese greensand processes were examined. Ion exchange was found to be unsatisfactory because of the high operating and maintenance costs and the high sodium residual introduced into the water. Sequestering would be an economical process but has problems connected with its operation such as a chance of exceeding the maximum phosphate level, the heating effect could render the sequestering agent unusable, the need for pH adjustment, and the doubt as to the ability of this method to remove manganese. Gravity filtration is unacceptable because of the high operational and maintenance costs and also the danger of high sodium residual levels. Pressure filtration is an economical and effective way to remove iron but to also remove manganese significantly increases the cost of this method. The costs of contact filtration substantially exceed those of pressure filtration, but this process will remove the manganese along with the iron.

*Water treatment, *Ozone, *Potable water, Iron, Manganese, Ion exchange, Filtration

Sequestering, Chemical oxidation, Gravity filtration, Pressure filtration, Contact filtration, Manganese greensand

D256
SWEDISH EXPERIENCES IN CHEMICAL TREATMENT OF WASTEWATER,

Ulmgren, L.

Scandiaconsult International AB,
Sweden

Journal Water Pollution Control Federation, Vol. 47, No. 4, p 696-703, April, 1975. 4 fig, 5 tab, 9 ref.

Sweden has more than 500 plants that are designed for the chemical treatment of sewage with or without biological treatment and more than 600 plants that use biological treatment alone. Chemical treatment is gaining in favor because of the restrictions of phosphorus content and BOD of the discharged effluent and also because the long winters in the northern part of Sweden make biological treatment unsatisfactory. The methods used for chemical treatment are direct (primary and secondary), simultaneous, and pre- and post-precipitation. Post-precipitation is used in 80-85% of the chemical treatment plants. Alum is used in 85-90% of the plants. Lime and bivalent or trivalent iron salts are also used. "Guidelines for Design of Sewage Treatment Plants" has been prepared by the Swedish National Environment Protection Board. Sections for coarse treatment and primary sedimentation should be designed to handle more than four times the hydraulic flow. Biological and chemical treatment processes should be able to handle up to two times the hydraulic flow. Lamella sedimentation has been successfully used for the separation of chemical flocs, but does not work well for separating biological flocs. The results of a survey of more than 50 municipal treatment plants for chemical precipitation conducted from 1971 to July 1973, indicate that the majority of the plants operate relatively well. The use of chemical precipitation for treating many different types of waste water in Sweden is expanding because of the fact that chemical precipitation will reduce the BOD, COD, and suspended solids of the discharged water in addition to removing phosphorus.

*Chemical precipitation, *Waste water treatment, *Phosphorus, *Nutrient removal

D257
THICKENING OF UNWANTED SPENT LIME REJECTS,

Christensen, D. R., and Prettyman, R. W.

Water and Sewage Works, Vol. 122, No. 5, p 102-104, May, 1975. 6 fig, 2 tab, 3 ref.

The Montgomery County Regional advanced waste treatment plant in Maryland is planning to treat its lime sludge by separating the unwanted materials (rejects) from the spent lime by centrifugation. The spent lime can be reused following recalcination. The rejects will be further settled in gravity thickeners before being pumped to dewatering equipment prior to final disposal. An investigation was conducted to obtain design data for the gravity thickening units. The tests were conducted with rejects from a centrifuge at the South Lake Tahoe advanced waste treatment plant in California. The experimental results were used to determine conservative design parameters for the Montgomery plant. Rejects from the centrifuge are expected to enter the thickeners at 3% solids. A 24 hr detention time in a 6 ft depth at 4% solids should result in a solids loading rate of 15 lb/sf/day. Two 90 ft diameter rejects thickeners with a 10 ft side water depth are the preliminary design recommendations. This design will produce a solids loading at a maximum flow of 16 lb/sf/day.

*Waste water treatment, *Centrifugation, Lime, Sludge treatment, Dewatering, Design criteria, Treatment facilities

Sludge thickening

D258
UPRATING HYDRAULICALLY OVERLOADED SEDIMENTATION TANKS BY INCLINED PLATES,

Gray, T. W., and Churchill, P. S.

Effluent and Water Treatment Journal, Vol. 15, No. 2, p 77-81, February, 1975. 2 fig, 4 tab, 9 ref.

High-rate sedimentation, by means of submerged inclined compartments, is becoming an established way to improve an existing overloaded municipal sewage treatment plant without expanding the facilities. CJB Developments is offering two high-rate sedimentation processes using inclined corrugated plates to assist in this upgrading. The first process is the uprating of existing sedimentation tanks using low-cost high-rate sedimentation modules of plastic construction. The second process is a purpose-built, fabricated, high-rate sedimentation tank. The second process requires less land than a conventional tank and lowers the risk of developing anaerobic conditions. Conventional sedimentation tanks can be either horizontal-flow or upward-flow type. Both types can be successfully uprated for solids settlement using high-rate sedimentation modules. There is very little surface attraction to the plates in the CJBD module of the type of solids found in primary or humus tanks. The supernatant liquid flows in a clear stream up the arch-forming corrugation on the corrugated plate while the solids form a counter-current flow down the troughs. Washing down has not been necessary on a pilot unit which has been in operation for two years in a humus tank.

*Sedimentation, *Waste water treatment, Treatment facilities, Settling basins, Sedimentation rates, Suspended solids

High-rate sedimentation

D259
UPRATING AND REDESIGN OF WATER TREATMENT PLANTS, PART II,

LaFontaine, E. O.

Water and Sewage Works, Vol. 122, No. 5, p 96-97, May, 1975. 1 fig.

The use of advanced engineering technology can be used to uprate many water plants to provide for greatly increased output. Increased output can often be effected through the use of new and better chemicals together with improved operating techniques without the need for physical disruption of the plant or new construction. Pressure filters and gravity filters may be uprated with properly designed pre-treatment facilities and chemical application. Filters may be rebuilt and uprated at a relatively modest cost. When rebuilding filters it may be desirable to replace the filter bottoms or under drain systems. The backwash system generally does not have to be rebuilt to perform satisfactorily with a rebuilt filter if it has performed well in the past. The installation of improved jet wash or air scouring equipment should be considered in an uprating program. Proper automatic control over the application of chemicals, rate of flow, filter operation, pump operation and emergency facilities will improve plant efficiency and insure a higher plant capacity. Uprating a plant will mean an increase in water which in turn may necessitate installation of new pipes, valves, and high lift pumps. A diesel generator set for standby power provides a significant improvement in operational efficiency under emergency conditions. A large clear water storage facility will also increase the capacity by providing the capability for operation under various load conditions.

*Water treatment, *Treatment facilities, *Water supply, Filters, Pumps, Automatic control, Water demand, Pipes, Valves

D260
INNOVATIVE WATER PLANT SLATED FOR NEW JERSEY,

Doe, P. W., and Inhoffer, W. R.

Havens and Emerson, East Paterson, New Jersey.

Water and Wastes Engineering, Vol. 12, No. 4, p 30-32, 66, April, 1975. 1 fig.

The Passaic Valley Water Commission's major treatment plant is located at Little Falls, New Jersey on the Passaic River and serves Paterson, Passaic, Clifton and eleven other north New Jersey communities. Improvements taking place at this plant will provide an innovative water treatment project which is one of the first in the country to include a comprehensive filter backwash water and alum sludge disposal scheme. These improvements are expected to be completed in the near future. Extensive investigation both on-site and in the laboratory into dewatering, off-site disposal, and on-site disposal went into the plans for this project. Four pumping stations, a chemical dosing system, a backwash water settling tank, a sludge thickening complex, and a sludge press house will make up the backwash water and sludge disposal facilities. Overflows have been provided in case of emergency. Some phases of the process will be completely automated.

*Treatment facilities, *Water treatment, *Waste water treatment, Sludge disposal, Planning, Investigations, Automation, Dewatering

Passaic Valley, New Jersey Water Commission, Filter backwash water, Alum sludge

D261
ENERGY-WASTEWATER TREATMENT AND SOLIDS DISPOSAL,

Garber, W. F., Ohara, G. T., and Raksit, S. K.

Hyperion Treatment Plant, Playa Del Rey,
California

Journal of the Environmental Engineering Division, ASCE, Vol. 101, No. EE3, p 319-332, June, 1975. 5 fig, 4 tab, 21 ref.

Effluent discharge standards and funding criteria established by control agencies as a result of the concern about environmental quality have affected the design and construction of waste water treatment facilities and waste water solids disposal systems. The increased energy needed for advanced treatment methods may actually increase the overall pollution. Work at the Environmental Protection Agency's Cincinnati Laboratories has shown that an activated sludge process for complete nitrification uses almost twice as much energy as treatment for carbonaceous oxygen demand removal alone. The amount of fossil fuel combustion to produce this energy would undoubtedly cause an increase in negative environmental impact. The State of California Water Resources Control Board has notified the City of Los Angeles that it must cease discharging digested-screened waste water solids into the anoxic-anaerobic deep waters and sediments of the Santa Monica Basin by the end of 1976. The City of Los Angeles has operated both chemico-physical and biological waste water treatment facilities. They have found that the chemico-physical treatment requires almost five times the amount of energy as biological treatment. Alternatives to disposal in the ocean are: pumping to evaporation ponds with disposal on sanitary landfills requiring 16 times the energy than ocean disposal; and, mechanical dewatering prior to sanitary landfill disposal requiring 35 times more energy than the present method.

*Waste water treatment, *Treatment facilities, *Environmental effects, *Energy, Biological treatment, Sludge disposal, Landfills, Bodies of water, Dewatering, Nitrification, Oceans

Environmental Protection Agency, State of California Water Resources Control Board, Los Angeles (Calif), Santa Monica Basin, Chemico-physical treatment, Anoxic-anaerobic deep water

D262
ADVANCED TREATMENT OF WASTE WATER AFTER SECOND STAGE TREATMENT. EXPERIMENTAL RESULTS AT THE WATER TREATMENT PLANT OF KAWASAKI CITY (Gesui niji shorisui no kodo shori, Kawasaki-shi gesui shorijo ni okeru jikken hokoku),

Mizushori Gijutsu, Vol. 16, No. 4, p 365, 1975. 23 fig, 17 tab.

The advanced purification of secondary treated waste water for reuse as industrial water was studied. Waste water treated by a conventional sewage plant is used as the raw water, and it is treated by coagulation with inorganic and organic reagents, followed by filtration, activated carbon adsorption, and electrodialysis or reverse osmosis. The raw water with 10 ppm turbidity may be improved to 2 ppm turbidity with the addition of 60 ppm inorganic and one ppm organic coagulating agents. The 75% to 95% of COD, TOC, and ABS were removed by an activated carbon, but adsorption of ammonia, heavy metals, and phosphates were difficult by the activated carbon. More than 90% removal of sodium, potassium, chloride, sulfate ions was achieved with 150 minute deionization by an electrodialysis technique, and water with the dielectric constant less than 100 microohm/cm could be obtained. However, insoluble salts and organic compounds were not removed by this method. The osmosis technique was also applicable to the purification of raw water, and purified water of industrial quality can be continuously produced for several hundred hours.

*Waste water treatment, *Water purification, *Tertiary treatment, *Water reuse, Coagulation, Filtration, Activated carbon, Adsorption, Electrodialysis, Reverse osmosis, Water treatment

D263
COAGULANT RECOVERY TAKES PLANNING,

Dunkle, C. G.

Water and Wastes Engineering, Vol. 12, No. 5, p 47-48, 104, May, 1975.

The recovery of coagulants from the waste sludge of water treatment plants demands the prior study of each specific coagulant and related methods of clarification. Several treatment facilities are discussed. For example, the recovery of alum at Tampa, Florida for reuse in the filtration plant gave odorless waste solids which could be stored before final disposal. Similarly, reclamation of lime and CO2 from chemical treatment plants at Dayton, Ohio, and St. Paul, Minnesota, lessened the final disposal problem and reduced the facilities' operational costs. In Montgomery, Alabama, lime and MgCO3 were recovered; the magnesium carbonate is recycled to remove color and turbidity from raw water. Applicability of polymers as primary coagulants, coagulant aids, and sludge conditioning agents are being investigated. Polymers are expensive but more efficient than alum. However, there is no universal polymer, and careful choice of specific polyelectrolyte is necessary for individual applications. The efficiency and economy of sludge production and handling indicated that a combination of alum recovery and horizontal vacuum filtration would require large capital and operating costs but would produce a useful end product, decrease the size of dewatering equipment needed, and reduce landfill requirements.

*Waste water treatment, *Sludge treatment, Lime, Recycling, Coagulation, Economics, Costs, Dewatering, Waste disposal, Polymers, Polyelectrolytes

*Coagulants, *Alum, Recovery, Magnesium carbonate

D264
THE APPLICATION OF MEMBRANE PROCESSES IN THE TREATMENT OF SEWAGE,

Sammon, D. C., and Stringer, B.

Atomic Energy Research Establishment,
Harwell, England,
Chemistry Division.

Process Biochemistry, Vol. 10, No. 2, p 4-12, March, 1975. 2 fig, 11 tab, 56 ref.

The membrane processes of reverse osmosis, ultrafiltration, and electrodialysis, now established for water treatment, are under evaluation for use in sewage effluent treatment. With an increasing reuse of sewage effluents, possible applications of membrane processes are in the reduction of salt content and of several organic species. Findings of published experimental work were reviewed. The major areas of investigation were: stability of flux and the mechanism of flux loss due to fouling; product quality with respect to a range of species; treatment of sludges; and economics and possible applications. It was concluded that direct reuse of sewage effluent for potable water has not yet received public acceptance. Costs of reverse osmosis rather than conventional treatment for water reuse at a less than potable quality level indicate that osmosis is not economically feasible. The state of the art currently is that pilot scale work has identified problem areas and indicated operational techniques. Except for the use of activated sludge treatment, coupled with ultrafiltration, membrane process applications for waste water treatment remains theoretical.

*Membrane processes, *Reverse osmosis, *Waste water treatment, Water quality, Activated sludge, Costs

Ultrafiltration, Electrodialysis, Effluent reuse, Salt removal

D265
SYNTHETIC SURFACTANTS IN URBAN EFFLUENTS AND THEIR RATE OF ELIMINATION IN BIOLOGICAL WASTEWATER TREATMENT PLANTS (Sinteticheskie poverkhnostnoaktivnye veshchestva v gorodskikh stokakh i effektivnost' ochistki ot nikh na biologicheskoy stantsii),

Kostovetskiy, Ya. I., Rakhov, G. M., and Shteynberg, Ye. I.

Gigiyena i Sanitariya, No. 2, p 95-96, 1975. 1 tab, 3 ref.

The efficiency of biological waste water treatment plants in the elimination of synthetic surfactants from municipal waste water was studied. Mechanical settling reduced the surfactant concentration, ranging from 2.2 to 5.3 mg/liter originally, by 5-16%, while biological coagulation increased the elimination rate to 30%. Biological filters and aeration tanks had efficiencies of 40-48% and 47-78.3%, respectively. The overall efficiency of biological waste water treatment plants ranged from 48 to 80%, depending on the initial concentration and on the efficiency of the mechanical purification stage. Surfactant concentrations up to 10 mg/liter did not interfere with the operation of biological ponds.

*Waste water treatment, *Treatment facilities, Surfactants, Coagulation, Filters, Aeration, Biological treatment

D266
ONE-STEP NITRIFICATION AND CARBON REMOVAL,

Stower, E. L., and Kincannon, D. F.

Oklahoma State University,
School of Civil Engineering.

Water and Sewage Works, Vol. 122, No. 6, p 66-69, June, 1975. 4 fig, 2 tab, 9 ref.

The rotating biological disc process has been shown to be very effective for biological nitrification. A two-year study from 1972 to 1974 was performed to determine the ammonia-nitrogen removal characteristics of a rotating biological contactor system operated at COD and NH3-N concentrations comparable to those of domestic waste water. Ammonia-nitrogen removal characteristics for shock loads were also studied. The principle of the rotating disc system is that the discs are partially submerged in waste water and the microbial population is passed alternately through waste water and air. The discs provide media to support fixed microbial growth, contact the growth with the waste water, and aerate the waste water to provide enough dissolved oxygen for aerobic biological activity. It was found that the system achieved complete nitrification at a hydraulic loading of 0.5 gpd/sq ft and influent COD and NH3-N concentrations of 250 mg/liter and 27.6 mg/liter, respectively. The first stage removed 82 percent of the ammonia-nitrogen, with all removed by the fifth stage. The majority of the COD was removed in the first stage of the rotating disc unit. Shock load experiments showed that ammonia-nitrogen removal increased with increased COD and NH3-N concentrations because ammonia-nitrogen could be incorporated into cellular matter instead of oxidized to nitrate-nitrogen. Variables affecting nitrification capacity of the process were seen to be temperature, pH, presence of inhibitors, total applied loading, and the COD or BOD to NH3-N ratio.

*Nitrification, Ammonia, Nitrogen, Chemical oxygen demand, Waste water treatment, Microbial degradation, Biological treatment

*Rotating biological discs process

D267
AN EXPERIMENT OF RAPID FILTRATION THROUGH DUAL-MEDIA BED FOR SECONDARY TREATMENT EFFLUENTS (Niso roka ni yoru niji shorisui no roka jikken),

Yoda, T.

Gesuido Kyokaishi, Vol. 12, No. 132, p 54-63, May, 1975. 10 fig, 2 tab, 11 ref.

Tertiary treatment of sewage water by a two layer filtration technique is studied. The filtration layers considered were sand with a 0.58 mm effective radius, anthracite with 1.0 mm or 1.2 mm radius, and the combination of sand and anthracite used in equal amounts for a total bed thickness of 600 mm. The cross section of the filtration bed was 0.63 sq m, and six of such filtration beds were used to treat the water after second stage treatment. The six filtration beds were combined at each bed outlet and the water filtered by each was mixed and discharged. The turbidity and BOD value of the filtered water were less than 6 and 8, respectively, for the sample water. The turbidity was 24 and BOD 28, at a filtration rate of below 600 m/day. The pH of the filtered water showed a slightly higher value than that of the unfiltered water; the former pH ranged from 7.25 to 7.80 and the latter ranged from 7.16 to 7.50. The best combination of layers was sand with the 1.2 mm radius anthracite.

*Waste water treatment, *Filtration, Coals, Tertiary treatment, Turbidity, Biochemical oxygen demand, Biological treatment

Sand

D268
PURE OXYGEN TREATMENT OF WASTEWATER,

Stetzer, R. H.

FMC Corporation,
Itasca, Illinois.

Pollution Engineering, Vol. 7, No. 5, p 42-45, May, 1975. 4 fig, 1 tab.

Pure oxygen systems are compared with conventional air activated sludge methods for biological treatment of waste water. Advantages of oxygenation are high removals of BOD, COD, and suspended solids, at reduced costs. A pure oxygen system using a diffuser design with operation in an open aeration tank has been developed. Oxygen dissolution generates micron-sized bubbles deep in the mixed liquor, producing oxygen transfer efficiencies over 90 percent. Uncovered tanks have no enclosed pure oxygen atmosphere and thus require no alarms. These tanks allow the CO2 gases to escape to the atmosphere, resulting in a higher pH in the mixed liquor, which is advantageous for nitrification. Automatic control is maintained by a system of dissolved oxygen probes and analyzers. Pilot facilities of pure oxygen are in operation at treatment plants in Englewood and Denver, Colorado. This system may be used to upgrade existing facilities, often without tank modification.

*Oxygenation, Biological treatment, Waste water treatment, Biochemical oxygen demand, Chemical oxygen demand, Aeration, Pilot plants, Suspended solids, Treatment facilities

Pure oxygen

D269
IN-LINE FILTRATION MAY BE JUST FOR YOU,

Venema, G. J.

Nalco Chemical Company, Chicago, Illinois.

Water and Wastes Engineering, Vol. 12, No. 5, p 50-52, 57, May, 1975. 1 fig.

In the past, filtration technology was concerned with rapid sand and high rate filters. Current research in filtration technology is directed at the definition of the parameters for deep-bed filtration, upflow filtration, direct filtration, and in-line filtration. In-line filtration is an alternative to coagulation/settling for treating low turbidity water. Treatment requirements for water quality goals are the primary concern of direct and in-line filtration. Increasing the allowable flow rate through a media is the concern of rapid sand, deep-bed, and upflow filtration. Therefore, direct and in-line filtration treatment methods can be applied to rapid sand, high rate, deep-bed, and upflow filters. In direct filtration, coagulation of solids occurs prior to filtration. Coagulation occurs during filtration in the in-line filtration method. In-line and direct filtration depend on the theories of mass-transfer of solids from the liquid to the media surfaces and physico-chemical attachment of solids to the media. The advantages of these methods are a reduction of chemical consumption, a lower sludge production, longer filter runs, and improved water quality. The performance of in-line and direct filtration depend on the type and amount of solids, filter media characteristics such as effective grain size, depth and type, filter operating parameters including degree of flow surges and filtration rate, and achievement of optimum coagulation. Both direct and in-line filtration make use of polymers for coagulation, particularly polycationics, which are polyamines having low to moderate molecular weight and high cationic change density.

*Filtration, *Waste water treatment, Water quality, Filters, Coagulation, Polymers, Mass transfer

Filter media, Solids, Polycationics, Physico-chemical treatment

D270
SEA WATER SOFTENING WITH THE LIME-MAGNESIUM CARBONATE (LMC) PROCESS,

Mavis, J. D., and Checkovich, A.

Burns and Roe Construction Corporation,
Fountain Valley, California.

Industrial and Engineering Chemistry, Process Design and Development, Vol. 14, No. 3, p 204-209, 1975. 4 fig, 3 tab, 10 ref.

A pilot plant to remove 70% of the calcium from sea water using the lime-magnesium carbonate (LMC) process was tested and improved. The advantages of the LMC process are that it does not depend on the sale of byproducts for its economic use, and all materials produced in the process are recycled for use in some other part of the process. Nominal chemical makeup is required. The two feedstocks required are limestone and fuel oil - all other materials in the process are derived from these. The four basic operations involved are softening, calcining, magnesium hydroxide production, and magnesium hydroxide carbonation. A prototype LMC plant was operated at the San Diego Test Facility by the Office of Saline Water, Department of the Interior. The utility of the LMC process as a pre-treatment for high temperature distillation desalting plants was demonstrated. The Test Facility experiments confirmed that an evaporator can be operated at a maximum brine temperature of at least 335 F, and that an LMC plant could be designed to have a high on-stream factor. The LMC pre-treatment is estimated to cost 5.1 cents per 1000 gallons of treated water for a plant sized to supply a 50 mgd desalting plant. The process may be useful with desalting processes using feed water more saline than the oceans.

*Sea water, *Water softening, Pilot plants, Distillation, Desalination, Evaporators

Lime-magnesium carbonate process, Calcining, Magnesium hydroxide production, Magnesium hydroxide carbination

D271
STUDY ON DIRECT RAPID FILTRATION USING REDUCED COAGULANTS,

Tsunoda, S., and Aoyanagi, Y.

Journal of Japan Water Works Association, No. 486, p 2, March, 1975.

The direct filtration of kaolinite suspensions by sand beds was investigated. The coagulant metal ions used in the direct filtration process were hydrolized in water, forming various polynuclear complexes. The pH was the most important factor in direct filtration; the particle attachment mechanism was controlled by pH. The kaolinite suspension under certain circumstances showed a preferred orientation on the sand surface. The coagulated particles in pH 4-5 settled into filter pores, and the pressure drop of the filter bed was small. Particles in pH 6-6.5 showed no preferred orientation with respect to the sand surface, and covered the sand particles uniformly. In pH 7-10, the particles settled mainly on sand surfaces already covered with coagulated particles, and pressure drop increased significantly.

*Filtration, *Kaolinite, *Suspension, Waste water treatment, Filters, Sands, Hydrogen ion concentration, Coagulation

Metal ions, Coagulated particles, Direct filtration

D272
ADVANCED WASTEWATER TREATMENT PLANT WITH DESIGNED-IN RELIABILITY,

Anderson, L. K.

Stevens, Thompson and Runyan, Incorporated,
Portland, Oregon.

Public Works, Vol. 106, No. 6, p 81-84, June, 1975. 2 fig.

In the mid-1950's the rapidly growing suburban area of Washington County, Oregon, faced sewage collection and treatment problems due to lack of a master plan; by the mid-1960's the urban creeks had become open sewers. A waste water management plan was drawn, which called for the formulation of an area-wide agency responsible for financing, constructing, and operating the proposed regional facilities. The Unified Sewerage Agency of Washington County was established. The master plan called for the elimination of all treatment plants in the tributaries of the Tualatin, the major river, and the construction or expansion of six major plants on the river itself. The first and largest of the new facilities is the Durham Advanced Wastewater Treatment Plant, which will have a 20 mgd capacity upon completion. It can be expanded to 60 mgd. Reliability is a critical factor in this plant, as it is located in a residential area, and because of the need to minimize pollutant discharges to the Tualatin River, especially in the low river flow season (May to November). Flow augmentation is part of the total design, for which purpose multipurpose storage reservoirs were constructed upstream. During the rest of the year less stringent discharge standards are in effect; a conventional activated sludge plant, which has automatic surge and bypass control, meets these requirements. Advanced treatment features of the plant include chemical treatment and filtration prior to chlorination and discharge of the effluent from the activated sludge process, and preparation of organic sludge for incineration.

*Planning, *Treatment facilities, *Waste water treatment, *Tertiary treatment, Construction, Financing, Rivers, Water pollution, Reservoir storage, Activated sludge, Filtration, Chlorination, Effluents

D273
A PLANT GROWS IN BROOKLYN,

Walter, C. R., and Lastihenos, J.

Hazen and Sawyer, New York, New York.

Water and Wastes Engineering, Vol. 12, No. 6, p 36-42, June, 1975. 7 fig.

The expansion and modernization of New York City's 26th Ward Water Pollution Control Plant was completed in May 1975 at a cost of $43 million. The existing regulators on the interceptor sewers were modernized to handle storm overflow automatically. The original screens were replaced by new units about 40 feet long, with a conveying mechanism carrying the screenings to dry, above-grade screen chambers. Grit removal is performed in cyclone degritters on a sludge/grit mixture taken from the preliminary settling tanks. Main sewage pumps were replaced with units incorporating variable speed controls. Automatic skimmers and new safety and sludge handling units were added to the preliminary settling tanks. The aeration process was upgraded by the installation of modern air diffusers and high-efficiency electrostatic air filters, the establishment of new step-aeration feed points, and the repair of joints in the aeration tanks. The eight original folded-flow final settling tanks were combined into four straight-flow tanks and equipped with modern sludge collection and scum removal equipment. Three new final tanks were also constructed. Two new chlorine contact tanks were installed with a total capacity of one million gallons. The hypochlorite storage and feed equipment was modernized and automated. Four new gravity thickeners were installed. Two of the original floating-cover digesters were modernized to fully mixed, high-rate digesters. The two other units were converted to sludge storage tanks.

*Waste water treatment, *Sewage treatment, *Treatment facilities, Interceptor sewers, Screens, Pumps, Settling basins, Aeration, Sludge treatment, Sludge disposal, Chlorination

Skimmers, High-rate digesters

D274
NOVEL WASTE TREATMENT VARIATION SHOWS GREAT PROMISE,

Brucker, C.

Water and Pollution Control, Vol. 113, No. 6, p 17, 19, 37-39, June, 1975. 3 fig.

A novel variation of the activated sludge technique for treating domestic sewage has been developed and patented. The Brucker system has been in operation in a plant in France for more than a year, and has been described as a single combined activation and settling tank that incorporates an aerating and recycling device. The unit treats waste water from a cheese plant at 170 kg of BOD per day. The waste receives no pre-treatment before entering the 180 cu m tank, and has a mean BOD of 2,000 mg/liter with peaks up to 5,000 mg/liter and pH from 4 to 11.5. The sewage is purified during its passage in horizontal flow through the single, combined, activation and settling tank of an elongated rectangular shape. Incoming sludge is received at the upstream end of the tank in a grit compartment bounded by a siphon partition. The tank has two zones, activation and settling, the volumes of which are variable. Sedimented sludge is sucked up by a screw pump, delivered upstream, and sprayed into the air. The oxygenated biological mass falls to the surface of the liquid in the tank, flocculates in the activation zone, and falls towards the bottom of the tank before being carried away by the screw pump to be recirculated. Energy consumption of the treatment plant is 130 kWh/day.

*Waste water treatment, *Sewage, *Activated sludge, Domestic wastes, Industrial wastes, Biochemical oxygen demand, Settling basins, Sludge, Treatment facilities, Aeration

Activation tank, France, Cheese production wastes

D275
THEY'RE PACKING UP WASTE PONDS,

Chemical Week, Vol. 116, No. 24, p 37, June 11, 1975.

An upflow packed-bed biological reactor, called an Anflow unit, has been developed by Union Carbide. This system is applicable for anaerobically treating liquid wastes from sewage and from various industries and in converting these wastes into chemicals or fuels. Liquid wastes are pumped into the bottom of this system and travel upward through the packing. Microorganisms have been implanted on the packing material and once they have been implanted they appear to regenerate without wearing out. One such column has operated for three years without adding to the microorganisms. The Anflow process can recover methane as off-gas during treatment of liquid wastes from starch, food processing, and from domestic sewage. The retention times for the system are as low as four hours.

*Packed beds, *Biological treatment, *Anaerobic digestion, *Liquid wastes, Microorganisms, Sewage treatment, Waste water treatment, Industrial waste, Methane

Anflow unit, Biological reactors, Chemicals recovery

D276
ALUMINUM SULPHATE FOR WATER TREATMENT,

Water Services, Vol. 79, No. 950, p 150-153, April, 1975.

Aluminum sulfate, or alum, is used as a coagulant for both industrial and municipal water treatment. The alum provides gelatinous precipitate of hydroxide which by physical and electrochemical means entrains the suspended and colloidal matter present in water after filtration. Because most colloidal impurities in water have a negative charge, and alum is charged positively, colloidal matter and particles of aluminum hydroxide floc are mutually attracted and form a precipitate which may be removed by filtration. The most economical form of alum for effluent treatment is Aluminoferric, available in slab block form; this substance is readily soluble in water and solutions of it can be metered into an effluent flow.

*Coagulation, *Waste water treatment, Municipal wastes

Alum, Coagulants

D277
TERTIARY STAGE ADDED TO STRATFORD SEWAGE PLANT,

Water and Pollution Control, Vol. 113, No. 5, p 14-16, May, 1975.

In order to meet stringent Canadian effluent quality standards, the city of Stratford, Ontario, was forced to improve its sewage treatment plant. Discharge is to a river of variable and sometimes very low flows, and the biochemical oxygen demand was to be limited to 300 pounds per day. The alternative chosen was tertiary treatment, built within the existing biological treatment facility. This supplemental effluent treatment consists of polishing by filtration, combined with nutrient removal. Better effluents were produced with the use of variable rate filters. A dual media filter was used with a larger size anthracite top layer above a finer sand layer. Backwash control was achieved by a differential pressure indicator for the flow in reverse direction to filtration. Performance tests on the new system indicated an average BOD5 value of 3.5 mg/liter. The tertiary treatment design capacity is 8 mgd. Thus, the maximum amount of BOD discharged on the river would be 280 lbs. BOD per day, which is within the required standards.

*Waste water treatment, *Tertiary treatment, *Treatment facilities, *Water quality standards, Filters, Flow, Rivers, Waste discharge, Biochemical oxygen demand

*Effluent quality standards

D278
THE ICI DEEP-SHAFT EFFLUENT-TREATMENT PROCESS,

Engineers' Digest, Vol. 36, No. 5, p 37, 39, May, 1975. 2 fig.

A process has been developed for high-intensity biological treatment of sewage or biodegradable industrial effluent. Based on circulating the liquid effluent by an air-lift principle in a deep shaft, the process also entails maintaining a culture of microorganisms in the effluent which are easily supplied with air, so that high treatment rates can be achieved. The shaft is divided into two sections, a downcomer and a riser. At the shaft head is a gas disengagement basin. Compressed air is injected into the riser at shallow depth. As circulation is established, the air is transferred to the downcomer where it is drawn down by liquid flow. Shaft depth can be from 100 to 300 meters achieved by conventional drilling and mining techniques. The air which provides the microorganisms with oxygen also initiates circulation, which makes the process simple and economical. Other advantages of this process are that the major part of the treatment stages are underground, thereby eliminating odor, and there is a minimal land requirement. The quantity of sludge produced is half that of the conventional activated sludge process, resulting in a substantial cost reduction. A pilot plant has been operating successfully since mid-1974 at the Billingham sewage works of the Northumbrian Water Authority.

*Waste water treatment, *Biological treatment, Sewage, Effluents, Microorganisms, Sludge, Costs

Northumbrian Water Authority, Billingham Sewage Works, Deep-shaft effluent-treatment process

D279
SIROTHERM DESALINATION,

Bolto, B. A.

CSIRO, Division of Chemical Technology,
Melbourne, Australia.

Chemtech, p 303-307, May, 1975. 10 fig, 14 ref.

An Australian desalination process has been developed which uses ion exchange resins but which achieves regeneration of the salt-loaded resins with hot water, rather than with chemicals. The process is effective on waters having up to 3000 mg/liter of dissolved salts, but is not suitable for the treatment of seawater. This Sirotherm process is economically and environmentally feasible for desalting low-salinity waters of natural or industrial origin because there are no costs for chemicals and the amount of waste salt discharged in the effluent is reduced significantly. A mixture of weakly basic and weakly acid resins is utilized whereby exchange sites are formed by proton transfer from the acidic to the basic groups, as in the overall equilibrium which is heat-sensitive. In order to best use the thermal regeneration phenomenon, it was necessary to develop special resins with capacities for salt adsorption plus rapid reaction rates. ICI Australia has plans for building a commercial Sirotherm unit of 165,000 gpd capacity in an industrial factory in South Australia to demonstrate the application of the process in desalting low-salinity industrial facility waters. Future studies, such as the desalination of sewage effluent, which will require pre-treatment, are being considered.

*Desalination, *Waste discharge, Effluents, Ion exchange, Australia, Water treatment, Waste water treatment, Resins

Sirotherm process

D280
FLOATING AQUATIC PLANTS REMOVE CHEMICALS FROM POLLUTED WATERS,

Water and Pollution Control, Vol. 113, No. 6, p 23, 25, June, 1975. 2 fig.

NASA's National Space Technology Laboratories (NSTL) in Bay St. Louis, Mississippi has been experimenting with water hyacinths to determine the plant's ability to absorb and concentrate toxic metals, and metabolize other chemical pollutants - phenols, creosols, insecticides, nitrates, and phosphates. In early 1975 large quantities of water hyacinths were planted in a portion of the 60-acre lagoon that serves as the city's total sewage disposal outlet. The planting begins a complex process that results in the total recycling of enormous quantities of water hyacinths. One month after initial stocking, plant harvesting begins; by this time the plants will have reproduced enough to appreciably reduce pollution levels. The harvested crop is subjected to procedures to determine impurity assimilation. Two methods under study by NSTL involve continual processing of the water hyacinths. Anaerobic fermentation converts shredded water hyacinths into bio-gas, similar to natural gas. The potential yield is expected to be 28,500 cubic meters of gas per acre of plants. Pyrolytic decomposition produces a mixed hydrocarbon fuel similar to bio-gas. Plants grown in domestic sewage effluent (low in toxic metal content) will be evaluated as an animal food source. Residues from these processes will yield high grade fertilizer. The advantages of the integrated aquatic plant disposal method are durability and low installation and maintenance costs. An obvious drawback is that it is limited to tropical and subtropical climate zones.

*Aquatic plants, *Pollution abatement, *Metals, *Waste water treatment, Nutrient removal, Absorption, Fermentation, Sewage, Water hyacinths, Costs, Phenols, Insectides

National Aeronautics and Space Administration, Chemical pollutants, Toxic metals

D281
TREATMENT PLANT TO BE TESTED FOR CARCINOGENS,

Riney, J. R., and Rowe, D. R.

Western Kentucky University, Kentucky,
Department of Engineering Technology.

Water and Sewage Works, Vol. 122, No. 5, p 110-112, May, 1975. 2 fig, 2 tab.

As part of EPA plans to test eighty public water supplies for the presence of potentially carcinogenic organic compounds, Owensboro, Kentucky's water system will be analyzed. The city is located on the Ohio River and has a rapidly expanding population of over 50,000. Owensboro does not use the Ohio River as its raw water supply source, but draws from twenty-six wells that are about 150 feet deep and penetrate an extensive aquifer that parallels the river. Existing and proposed methods of treatment for the city's water treatment plant are discussed. Present treatment involves aeration, coagulation, sedimentation, rapid sand filtration, and chlorination. The chemical composition of the finished water supply meets Federal and Kentucky Drinking Water Standards. However, the system will be improved with a ten mgd reactor-clarifier, which will combine flash mixing, flocculation, and primary sedimentation into one tank. Increased efficiency has also been achieved by split treatment to remove all of the magnesium and calcium hardness, which is particularly important for well water supplies such as these. Other additions to the Owensboro treatment plant include new filtration units, a control building facility, and a renovated lime sludge waste system.

*Municipal water, *Water supply, Public health, Waste water treatment, Pollutant identification, Wells, Water quality standards, Treatment facilities, Filtration, Aeration, Chlorination, Kentucky

Carcinogens, Well water supply

D282
BERRY HILL SLUDGE TREATMENT WORKS,

Cassidy, J. E.

Wessex Water Authority, Great Britain,
Avon and Dorset Recovery Division.

Water and Waste Treatment, Vol. 18, No. 4, p 17-19, April, 1975. 6 fig, 3 ref.

The sewage treatment facility for Bournemouth has been constructed in two stages and at two locations and was designed to serve a population of 200,000. The main sewage treatment works located at Holdenhurst consists of inlet channels, comminutors, detritors, sedimentation tanks, aeration activated sludge units, final settling tanks, nitrifying filters, and storm tanks. In order to override certain objections, the sludge treatment works were constructed two miles away at Berry Hill. The Berry Hill plant consists of raw sludge thickening wells, primary and secondary sludge digestion tanks, sludge drying beds, and a site for filling tankers which dispose of the digested sludge on farmlands. The sludge is pumped from the main sewage treatment plant at Holdenhurst. In order to minimize odor problems at Berry Hill, sludge thickening tanks to separate supernant water from the sludge have been equipped with fiberglass covers for the tanks and deodorizing systems. After thickening, the sludge is pumped to the digestion tanks and then to the drying beds for further dewatering. Following treatment the sludge is taken to farmlands for land disposal.

*Treatment facilities, *Sewage treatment, *Waste water treatment, *Sludge treatment, Channels, Aeration, Activated sludge, Filters, Odor, Dewatering, Sludge disposal, Digestion tanks, Settling basins

Berry Hill Sludge Treatment Works, Comminutors, Detritors, Land application, Sedimentation tanks, Settling tanks, Storm tanks, Sludge drying beds, Sludge thickening wells

D283
REMODELLING AT NORWICH,

McVie, A.

D. Balfour and Sons,
Great Britain.

The Consulting Engineer, Vol. 39, No. 5, p 30-31, May, 1975.

The Norwich, Great Britain, sewage treatment plant is currently being remodelled. Integration of the existing plant and the new extensions will provide four parallel treatment streams. In two of the parallel systems, sewage will be treated by biological filtration and activated sludge. The other two parallel systems will process sludge by digestion and pressure filtration. A new inlet works comprised of main flow measuring facilities, duplicate rotating fine drum screens, and duplicate detritors to deal with the whole flow has been constructed. The new activated sludge plant has four radial-flow primary settlement tanks and six diffused-air aeration channels. It uses magnetic flow meters and butterfly valves so automatic control can be employed to control the process. The effluent passes to four final radial-flow settlement tanks before discharge into the River Yare. The present sludge digestion system is also being modified. The site services have also been extended. Methane produced by the digestion system is used as the primary fuel for the new boilers.

*Treatment facilities, *Waste water treatment, Filtration, Activated sludge, Digestion, Aeration, Automatic control, Butterfly valves, Methane, Sludge disposal

Norwich, England, River Yare, Flow meters

D284
SEWAGE TREATMENT BY ACTIVATED CARBON: SORPTION OF THE HIGH MOLECULAR WEIGHT MATERIAL ON ACTIVATED CARBON FROM AQUEOUS SOLUTION (Kasseitan ni yoru gesui shor: kobunshi-ryo bushitsu o fukumu suiyoeki no shuchaku),

Tatemoto, H., Shimada, Y., and Kitagawa, M.

Gesuido Kyokaishi, Vol. 12, No. 131, p 58-66, April, 1975. 15 fig, 3 tab, 59 ref.

Sorption rates of sucrose, glucagon, and lactalbumin by different types of activated carbon were studied. The activated carbons examined included granular carbon, coconut carbon, Pittsburgh carbon, zinc chloride activated carbon, and gas activated carbon. Fifty mg of sucrose, glucagon, or lactalbumin was dissolved into one liter of water. The chemical concentration in the solution after treatment with activated carbon was then measured. The k and 1/n value in the Freundlich equation were determined for these three compounds. The 1/n value increased in the order of sucrose, glucagon, and lactalbumin, while the k value decreased in this order. The sorption of sucrose by all carbons tested was stronger than that of glucagon or lactalbumin, and the adsorbed amount by activated carbon decreased with increasing molecular weight of the compounds. Eighty to 100% removal of sucrose from the initial solution was achieved by all carbons within 2 hours. Glucagon removal was 50% after 24 hr, and improved to 80 to 90% after 38 hours. The lactalbumin removal was below 20% after 24 hr, and 90% removal was obtained only with the Pittsburgh carbon after 42 hours. The distribution of pore sizes in activated carbon was examined by a gel-filtration method, and was related to the sorption efficiency. The sorption efficiency was affected by pore size distribution for the compounds with a molecular weight between 4000 to 18000. The activated carbon with a higher porosity in the micro-pore range tended to adsorb these molecules with a higher efficiency. The surface area per carbon weight was not the determining factor for the sorption efficiency.

*Waste water treatment, *Sewage treatment, *Activated carbon, *Sorption, Adsorption, Organic compounds, Separation techniques, Tertiary treatment

D285
EVALUATION OF A COAL-SEWAGE TREATMENT PILOT PLANT,

Research and Development Report No. 63, no date. 58 p, 8 tab, 24 ref.

A pilot plant study on the feasibility of a coal filter process for treating raw sewage was performed. Treatment comprises passing sewage through a bed of small uniformly sized coal particles where filtration of the suspended solids and adsorption of dissolved organics occurs. The coal treatment process and the equipment it requires, the efficiency and costs of the method, the applicability and further developments of the process are discussed. Coal filtration is also discussed in relation to other treatment methods. Coal filtration is an excellent method for suspended solids removal, but only partially reduces the dissolved organics content. One-step coal filtration will not produce water which meets the current water quality standards. However, the use of coal char or activated carbon may increase the efficiency sufficient to allow for the one-step treatment of sewage. The most promising application of coal filtration is as a pre- or post-treatment step for suspended solids removal combined with a treatment step for dissolved solids removal. Coal filtration can be economically competitive if heat is recovered from all the coal used. This can be achieved by borrowing coal from a pulverized coal user. The estimated cost of development, construction, and operation of a one mgd demonstration plant for one year is $1,500,000.

*Waste water treatment, *Sewage treatment, *Coals, Filters, Suspended solids, Dissolved solids, Adsorption, Costs, Activated carbon, Pilot plants

Coal filtration

D286
OPERATIONAL VARIABLES AND LIMITATIONS OF DIRECT FILTRATION,

Hutchison, W. R.

Ministry of the Environment, Toronto, Ontario,
Canada, Water Technology Section, Pollution Control Branch.

Research Report No. W54, January, 1975. 118 p, 14 fig, 35 tab, 42 reg, 29 append.

Some of the operating limitations of water treatment by direct filtration during periods of raw water turbidity greater than 20 Ftu or diatom levels of 500 Asu/ml and the results of a pilot plant study on the effect of various operating variables are presented. The lengths of filter runs vary inversely with the suspended solids loadings excluding algae. Alum was the dominant factor in determining the overall filter run length. Alum and ferric chloride produced similar quality effluent. Cationic polyelectrolytes were able to lower the alum requirements. If diatoms were absent, the best effective size of coal, with respect to effluent quality, length of filter runs, and floc distribution within the filter bed, was approximately 1.05 mm. In dual media filters, the effluent turbidity was not a function of the effective size of the coal within the size range from 0.9 to 1.55 mm. The optimum headloss distribution for maximizing filter runs was about 75% for coal and 25% for sand. Diatom levels as low as 200 Asu/ml changed the headloss distribution within the filter bed. Filter coal with an effective size of 1.5 mm operated with diatom levels averaging 2500 Asu/ml produced filter runs longer than 12 hours at 4 Igpm/sq ft. The chance of filter breakthrough was increased by increasing the effective size of the coal or sand, the alum dosage, the filtration rate, the flocculation gradient above 20/sec and the flocculation time to more than 10 minutes, or by decreasing the depth of media. Polymers prevented breakthrough on all media sizes up to 1.55 mm under all conditions tested. An increase in the pH resulted in a deterioration of the final effluent quality.

*Water treatment, *Filtration, *Suspended solids, Coals, Efficiencies, Separation techniques, Water quality control, Diatoms, Polymers, Polyelectrolytes, Algae, Pilot plants

D287
BIOLOGICAL FILTERS,

Bunch, R. L.

Environmental Protection Agency,
Cincinnati, Ohio,
Advanced Waste Treatment Research Laboratory.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1258-1261, June, 1975. 24 ref.

A state-of-the-art review is given for publications concerning biological filters. Trickling filters may be used to improve effluent quality of an activated sludge facility. Overloaded trickling filters may be upgraded with the addition of ferric chloride before primary sedimentation, and by improvement of hydraulics. Operational controls for winter performance of a trickling filter have been developed such that effluent standards are met. High rate biological film flow reactor theory for optimal design was studied. Many high rate trickling filters use plastic media and have been shown to be economical. Other work included the effect of NTA on a trickling filter and the NTA removal capability of the trickling filter; at tested levels, NTA had no effect on filter efficiency. Comprehensive study of the rotating biological disk (RBD) process is being conducted in several countries. In the United States, the method has provided substantial electric power cost savings. The effects of influent loading, flow rate, rotational disk speed, detention time, disk surface, and liquid temperature on the efficiency of the RBD process are being investigated for future use in achieving nitrification.

*Reviews, *Waste water treatment, *Trickling filters, Activated sludge, Design criteria, Costs, Electric power costs, Nitrification, Plastics

*Biological filters, *Rotating biological disks

D288
ACTIVATED SLUDGE,

Schroeder, E. D.

California University,
Davis.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1261-1269, June, 1975. 101 ref.

A literature review on the topic of activated sludge is given. Rate models for microbial growth and a comparison of solids retention time (SRT) and food:microorganisms (F:M) ratio have been investigated. Kinetic models have been proposed, including the effects of limiting nutrients on a stable steady state. Process control was reviewed. Methods of control were: wasting from the mixed liquor to control sludge age; hydraulic control of activated sludge processes; and wasting from the recycle line. Feed forward control has also been based on influent filtrate TOC concentration, by changing the recycle rate. Design and operation of activated sludge plants have been achieved by various operational aspects of the contact stabilization process. The biochemistry and microbiology of batch and completely mixed processes have been analyzed. Raw influent, primary effluent, activated sludge mixed liquor and final effluent have been examined to find which bacteria are capable of producing specific enzymes. Toxic and refractive materials such as heavy metals and surfactants, which must be removed by the activated sludge processes, were studied. Joint treatment of municipal and pulping wastes in pilot plant studies, as well as design studies for treating synthetic rubber wastes and refinery waste waters, have been reported. The principles of aeration and the selection of aeration equipment were reviewed. Temperature effects on nitrification rates are being investigated; phosphorus removal is also being implemented. Other considerations were sludge thickening and disposal, and the use of package treatment plants as related to cost optimization.

*Activated sludge, *Waste water treatment, *Reviews, Model studies, Aeration, Bacteria, Microorganisms, Treatment facilities, Sewage treatment, Sewage bacteria

D289
LAGOONS AND OXIDATION PONDS,

O'Brien, W. J.

Kansas University,
Lawrence, Kansas.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1269-1273, June, 1975. 37 ref.

A review of the 1974 literature on lagoons and oxidation ponds is presented. Equations for designing stabilization ponds have been based on BOD removal and on the minimum rate of solar energy input into a pond. A mass balance equation was developed including algal synthesis, aerobic and anaerobic metabolism, changes in volumetric storage, and characteristics of influent and effluent of a primary oxidation pond. Mixing characteristics of proto-type aerated lagoons have been investigated. Biodegradation of NTA in pilot single cell ponds was measured. Inhibition of planktonic algae maturation in ponds was purported to have been produced by the discharge of methylsilicone oil and other organic compounds into the waste water collection system. Kinetic models were proposed for die-off rates of fecal bacteria in anaerobic ponds. Research has also been directed towards methods for algal removal from oxidation pond effluents. Experiments with intermittent sand filters were conducted; performance was seen to be dependent on effective sand size, hydraulic loading, and lagoon effluent quality. Multiple-cell, fill and draw lagoons were also analyzed for BOD and fecal coliform concentration in daily composite samples. The TSS concentration remained below 30 mg/liter and these lagoons consistently met EPA secondary discharge standards. Other studies on lagoon systems included experiences in cold climates, biological organisms for suspended solids removal from lagoon effluents, and cost-effectiveness analyses.

*Reviews, *Waste water treatment, *Lagoons, *Ponds, Biochemical oxygen demand, Aeration, Surfactants, Biodegradation, Algal removal, Biological treatment, Bacteria, Kinetics

*Oxidation ponds, Stabilization ponds

D290
DISINFECTION,

Davis, E. M., Moore, J. D., Casserly, D., Petros, J., and DiPietro, W.

Texas University, Houston.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1323-1334, June, 1975. 125 ref.

A literature review on disinfection of water and waste water and its related problems has been completed. Applications of disinfection include ozone, halogen, lime, ultraviolet radiation, and heat. The effectiveness of these methods is measured quantitatively in terms of various bacterial levels and has been studied through epidemiology. The use of chlorine as a disinfectant for municipal and industrial waste water is well documented. Unanswered problems of chlorine use include suitable doses and contact times, the need to continuously monitor residual chlorine concentrations, and the disinfection efficiency of chlorine in terms of chlorine-resistant organisms which have recently been found. Ozone technology has been investigated for use in potable water treatment, for killing most salmonellae and viruses, for removing color from water, and for eliminating refractory organics. Its uses also include pre-treatment before chlorination application, disinfection of industrial wastes, and degradation of phenols. Other disinfectants and combinations of them are reviewed, such as additions of high lime concentrations to waste water for virus removal. Sporicidal properties of hydrogen peroxide were evaluated and bromine chloride was also proposed as an alternative to chlorine because of its inherent reduced environmental hazards. Gamma radiation sources have also been suggested for waste water disinfection and fish toxicity data presented thus far indicated that the method is safe.

*Waste water treatment, *Reviews, *Disinfection, *Chlorination, *Ozone, Ultraviolet radiation, Bacteria, Municipal Wastes, Phenols, Industrial wastes, Bioassay, Potable water, Epidemiology

D291
LAND DISPOSAL OF WASTEWATER,

Tofflemire, T. J., and Farnan, R. A.

New York Department of Environmental Conservation, Albany.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1344-1352, June, 1975. 111 ref.

A review of recent literature on land disposal of waste water included publications and proceedings from a number of conferences. Advantages and limitations of three types of land disposal—irrigation, overland flow, and rapid infiltration-percolation—have been compared. Spray irrigation systems were found to remove BOD, COD, ss, phosphate, nitrogen, metals, bacteria, and viruses well, but did not remove sodium and chloride. Further research relating to septic tank systems is warranted in the areas of: permeability or percolation tests; alternate designs; metal retention; nitrogen removal; and virus removal. Groundwater injection regulations as related to the new safe water drinking act were mentioned. Individual systems of land disposal were outlined, including a pilot rapid infiltration system in Arizona, recharge beds receiving primary effluent in Massachusetts, recharge beds at Lake George, New York, which receive secondary effluents, septic tank tile fields in Florida and Oregon, spray irrigation in Australia, lagoon systems in Michigan, and irrigated marshes in Upton, New York. Nutrient travel has been monitored, particularly for phosphorus. Technical aspects of land disposal included mathematical models and computer programs for surface water flow, unsaturated groundwater flow, saturated groundwater flow, and nutrient transport. Federal and state control of injection wells is discussed, and mathematical models of waste water flow from injection have been developed.

*Reviews, *Waste disposal, Irrigation, Infiltration, Nutrient removal, Biochemical oxygen demand, Nitrogen, Bacteria, Ultimate disposal, Septic tanks, Monitoring, Groundwater

*Land disposal, *Rapid infiltration-percolation, Spray irrigation

D292
WASTEWATER COLLECTION,

Singh, T.

H. D. Nottingham and Associates, Incorporated, McLean, Virginia.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1335-1338, June, 1975. 41 ref.

A review of current literature on waste water collection systems is given. Sewer design was studied, and use of lower per capita flows and a design period of 25 years rather than 50 years were recommended. Models to optimize drainage networks based on linear programming have been developed. Constructuon details of long outfall sewers are outlined. Combined sanitary and storm sewer plans, aligned by laser light, are also described. Flow smoothing in sanitary sewers has been investigated; holding basins are meant as a supplemental tool rather than a replacement for the conventional gravity system. The use of materials such as polyethylene pipes was also discussed. Infiltration/inflow problems are major areas of concern. Sewer monitoring methods and measuring devices have been tested. Smoke detection of leaks and surface flows has been implemented as has closed circuit TV for sewer inspection. Sewer maintenance, repair, and cleaning are areas of neglect. Attention should be given to preventive maintenance, such as regular hydraulic cleaning, and rehabilitation by slip-lining with ultra high molecular weight polyethylene pipe in the cases of deteriorating concrete pipes.

*Reviews, *Waste water treatment, *Sewers, *Sewerage, *Sewage treatment, Outfall sewers, Maintenance, Combined sewers, Monitoring, Infiltration, Inspection, Inflow, Plastic pipes, Linear programming

Television inspection, Sewer monitoring, Waste water collection

D293
NEW ORLEANS CHOOSES OXYGEN ACTIVATED SLUDGE,

Civil Engineering, ASCE, Vol. 45, No. 6, p 84, June, 1975.

A secondary treatment plant is being built to handle New Orleans waste water. Because this is a new facility, a choice existed between air activated sludge and oxygen activated sludge. With air activated sludge, reductions in BOD and SS were predicted at 85%. In a pilot test of an oxygen system, BOD removals were 90-95% and SS removals were 87-93%. Thus, the oxygen activated sludge process was implemented, and will be complete in 1976. Advantages of the oxygen method are that it requires less aeration tank space; it can handle more variation in flow rate, sewage strength, and storm flows; it utilizes covered aeration tanks, eliminating hazards of splashing, aerosols, and odors; and costs will be lower. Disadvantages of the system are that preventive measures must be taken against leaks; careful selection of metals must be made, as oxygen is corrosive to many metals; and about every two years, on-site generators will have to be repaired and/or overhauled, necessitating temporary and expensive trucked-in oxygen. The new facility will require on-site oxygen generation using two 70 ton cyrogenic generating units. Plant costs will be about $29 million, or about $240,000 per mgd treated effluent.

*Waste water treatment, *Activated sludge, *Sewage treatment, *Construction costs, Treatment facilities, Pilot plants, Biochemical oxygen demand, Oxygen costs

Secondary treatment, New Orleans (La), Oxygen activated sludge

D294
MINNEAPOLIS KEEPS ON TRUCKIN',

Taflin, C.O., Weber, N. F., Kramer, A. J., and Whitaker, J.

Minneapolis Water Works, Minneapolis, Minnesota.

Water and Wastes Engineering, Vol. 12, No. 5, p 24-29, May, 1975. 3 fig, 3 tab.

Minneapolis has instituted a three part program for pollution control of its water works, which includes recycling filter washwater, construction of a sludge dewatering plant, and an investigation to determine the feasibility of lime recycling. The sludge dewatering plant is a building in two parts, a single story low portion which is made of face brick with concrete block backing, and a higher portion which is insulated sandwich paneling over a structural steel frame. The earth color scheme and attractive landscaping give it an acceptable appearance. The building which houses the water softening operation contains the office of the management of the complex. Two steel tanks were provided for in-process sludge storage. The larger is outdoors, and the smaller (used for polymer storage) is indoors. A 1500 KVA substation was constructed to power the plant. The plant is expandable to house a future calcining operation. The major mechanical failure during the first 1 1/2 years of operation was leakage from the sludge tank sludge gates, which were replaced. Also, freezing of the sludge cake in the surge tank occurred during plant start up. By increasing lime dose in the softening plant this problem was solved. The feasibility of lime recycling with the standard lime-alum softening treatment was investigated. It is economically feasible only if the purchase of lime and CO2, and dewatering trucking are eliminated. Experimentation was begun on a lime-magnesium biocarbonate softening process. No conclusive data is available; further testing with magnesium will include the use of polymers.

*Treatment facilities, *Waste water treatment, *Dewatering, Sludge treatment, Construction, Lime, Economic feasibility, Magnesium, Polymers, Testing, Minnesota, Calcium, Recycling

D295
SLUDGE TREATMENT, UTILIZATION, AND DISPOSAL,

Dick, R. I.

Delaware University, Newark, Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1306-1323, June, 1975. 255 ref.

A review of recent literature discusses treatment, utilization, and disposal of sludge. Recycling and landspreading procedures must consider public health and safety before new methods of sludge management will gain public acceptance. Sludge properties, such as viscosity, rate of solubilization of carbohydrates, and chemical composition, have been measured. Recovery of potentially valuable waste constituents, which might also be toxic, is suggested. Of particular interest is heavy metals, and the possibility of recovery by solvent extraction, ion exchange, reverse osmosis, electrochemical methods, adsorption, or complex formation with polyelectrolytes. Water treatment plant alum sludge handling presents another set of alternatives. Sludge conditioning by chemicals and by polyelectrolytes has been investigated. The effect of thickener size on the cost effectiveness of other sludge treatment processes was reported. Sludge dewatering processes were also reviewed, with simulation models and pilot scale tests. Incineration, wet oxidation, and heat drying are viable solutions for disposal in some situations. Reclamation of sludges as fuels is currently under study. Types of ultimate disposal include the controversial ocean dumping practices, liquid sludge application of agricultural land, trenching, heat drying and sale as fertilizer, and application to abandoned strip mines. Ecological impact of application must be considered, particularly the sources, fate and effects of trace elements in sludges, when applied to soils.

*Reviews, *Waste disposal, *Sludge treatment, *Sludge disposal, Reuse, Public health, Toxicity, Heavy metals, Dewatering, Ultimate disposal, Simulation analysis, Incineration, Waste water treatment

Sludge conditioning, Ocean dumping

D296
OKLAHOMA PLANS AHEAD FOR WASTEWATER REUSE,

Benham, D. B., Fountaine, L. C., and Brune, P.

Benhan-Blair and Affiliates, Incorporated, Oklahoma City.

The American City, Vol. 90, No. 7, p 34-35, July, 1975.

A new municipal waste water treatment facility in Lawton, Ohio, has been designed to meet state effluent criteria with less than 15.0 mg/liter BOD21 and phosphorus concentrations under 1.0 mg/liter. Resultant water of this high quality will be purchased by the electric utility serving the area for cooling use in the generation of electric power. Within the facility, raw sewage will pass through a set of three mechanically-cleaned bar screens for solids removal. Preaeration tanks will operate with a detention time of 58 minutes to provide flocculating action, enhancing the removal of ss in primary tanks, and introducing some dissolved oxygen. Three FMC primary settling tanks will be initiated, with space allowed for a fourth. Secondary treatment will consist of two steps: carbonaceous treatment with plastic media trickling filters; and nitrification by the activated sludge process. Final clarifiers will remove biological sludge formed from the nitrification tank, using suction type sludge removers rather than conventional scrapers. A tertiary stage will be employed to remove phosphorus from the waste water by chemical precipitation using lime, alum, and coagulant-aid polymers. After chemical phosphorus removal, two-stage recarbonation with intermediate settling filtration through sand-anthracite filter beds, and final chlorination disinfection will be accomplished. Sludge from the primary and secondary processes will be dewatered and incinerated; sludge from phosphorus removal will be thickened and stored on site for periodic removal.

*Waste water treatment, *Treatment facilities, Tertiary treatment, Sewage treatment, Nutrient removal, Filtration, Trickling filters, Nitrification, Dewatering, Incineration, Chlorination

Effluent standards, Secondary treatment

D297
ANALYSIS OF REVERSE OSMOSIS FACILITIES, GREENFIELD, IOWA,

Knowles, B. W.

National Waste Supply Improvement Association Journal, Vol. 2, No. 2, p 29-34, July, 1975. 2 fig, 2 tab.

The DuPont Permasep B-9 system for reverse osmosis treatment has been implemented in Greenfield, Iowa, since 1971 as an auxillary water supply from previously useless raw well water. This is the first reverse osmosis facility to have been built for municipal use. The system consists of three separately controlled units, each containing 24 parallel mounted permeators, a high pressure multistage centrifugal pump, and necessary instrumentation, hardware, and piping. Water quality for the three years of operation has been signficantly better than the recommended 500 ppm TDS. Maintenance involves cleaning iron precipitate built up on the membranes, if and when pressure drop exceeds 50 psi. Brine disposal is achieved by discharge to a storm sewer. Operational costs are approximately $30.30 per 1000 gallons, excluding amortization.

*Reverse osmosis, *Water treatment, Water supply, Wells, Pumps, Instrumentation, Water quality control, Maintenance, Waste discharge

D298
ANAEROBIC PROCESSES,

Ghosh, S., and Conrad, J. R.

Institute of Gas Technology, IIT Center, Chicago, Illinois.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1278-1805, June, 1975. 156 ref.

A literature review on the subject of anaerobic processes has been prepared. Some of the many studies included: observation of pathways of glutamate fermentation; detection of Na as an obligate growth requirement of several strains of common rumen bacteria; degradation of various organochlorine and organophosphorus insecticides in flooded soils; review of thermodynamics, pathways, and mechanisms of anaerobic fermentation and anaerobic sulfate reduction by bacteria present in marine sediments; effect of facultative growth on the redox potential of the microbial cultures; and study of factors affecting biological denitrification of waste water by pure cultures. It was suggested that more research be conducted on the fundamental microbiology and mechanism of the energy-yielding, hydrolytic, and gas-forming processes in anaerobic waste fermentation. Many investigations describe the role of anaerobic denitrification for nitrogen removal in soil strata used for the treatment and/or final disposal of applied wastes. Design and operation of digestion tanks and related equipment are outlined. Comparisons were also made between several sludge stabilization systems. Specific applications of anaerobic digestion are detailed, such as for food processing wastes, textile wastes, agriculture and livestock wastes, municipal solid wastes, and landfill leachate treatment. Additionally, the potential for energy reclamation by anaerobic bioconversion of all types of organic wastes to CH_4 is under serious consideration.

*Waste water treatment, *Anaerobic conditions, *Anaerobic digestion, Bacteria, Thermodynamics, Denitification, Microbial degradation, Reviews, Fermentation, Methane bacteria, Organic wastes, Industrial wastes, Municipal wastes

D299
COLUMN SETTLING TESTS FOR FLOCCULANT SUSPENSIONS,

Zanoni, A. E., and Blomquist, M. W.

Envirex Incorporated, Milwaukee, Wisconsin, Environmental Science Division.

Journal of the Environmental Engineering Division, ASCE, Vol. 101, No. EE3, p 309-318, June, 1975. 7 fig, 7 ref, 3 append.

The sedimentation process is used in almost all waste water treatment and many water purification plants. No one design approach can be used for all applications. The settling behavior of flocculant suspensions is not amenable to a mathematical description. It is necessary to employ a settling test in order to predict the performance of a settling basin. A recommended standard column settling procedure for suspensions with 2,000 mg/liter solids is as follows: construct a 2.67 inch settling column out of 100 m ID clear plastic with wall thickness of 6.3 mm; drill eight 13 mm holes in a straight line at 0.3 m intervals along column length, beginning with first hole 0.38 m from top; insert and seal 13 mm OD by 6.3 mm ID clear plastic nipples 50 mm long each hole, making certain they do not extend beyond the inside face of the column; attach a 76 mm length of latex tubing on each and seal ends with pinch clamp; seal column bottom with clear plastic disk (wall thickness of 13 mm); tap center of disk with a 19 mm pipe thread and insert a 19 mm galvinized nipple and brass gate valve with a 19 mm threaded outlet for a garden hose; support columns to wall tightly; place 25 liters of waste water in a 0.08 cu m plastic garbage can; stir; bring to room temperature quickly; pump test liquid into column using the open gate valve (leaving the stirrer on); close valve and let suspension stand 5 minutes; start timer and sample from each port from top down, then sample again after 25, 50, 75, and 100 minutes; proceed with suspended solids analyses; calculate percentage suspended solids removal values; plot removal values at appropriate depth and settling times; interpolate between plotted values to construct 130 percentage removal lines.

*Waste water treatment, *Laboratory tests, Sedimentation, Columns, Plastics, Suspensions, Suspended solids, Sampling, Settling basins, Analytical techniques

Column settling tests, Flocculant suspensions

D300
PHYSICAL AND CHEMICAL METHODS,

Scaramelli, A. B., and DiGiano, F. A.

Massachusetts University, Amherst, Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1249-1258, June, 1975. 111 ref.

Literature pertaining to physical and chemical processes for waste water treatment was reviewed. In selecting alternative methods of advanced waste treatment, the nature of raw waste water, effluent standards, process reliability, sludge production, and costs should be considered. Such methods include ozonation, carbon adsorption, chemical coagulation, ammonia stripping, breakpoint chlorination, ion exchange, mixed-media filtration, and reverse osmosis. Pilot scale tests have been conducted on various combinations of these physico-chemical processes. Low alkalinity waste waters, such as are found in storm water and combined sewer overflows, may be treated with the addition of 2 to 4 mg/liter silica to reduce the lime coagulation requirement and thus the sludge volume. Chemical coagulants such as ferric chloride have been used to upgrade overloaded trickling filter plants. Polyelectrolytes have been used for waste water treatment but require particular care in handling and preparation. Granular filters and liquids-solids separators are also being developed. Applications of carbon adsorption have been reviewed; results are presented in terms of adsorber design, reactivation, selectivity, and adsorption isotherms. Activated carbon is used, often along with activated sludge, for removal of organics, nitrogen, and odors. Ion exchange resins for nitrate, phosphate, and ammonia removal from secondary effluent, for desalination of brackish water, and for heavy metal removal are described. Membrane processes are also used for organic compound removal. Ozone as a unit process in the field of waste water treatment and its several applications, is also presented.

*Waste water treatment, *Reviews, Tertiary treatment, Coagulation, Ion exchange

D301
BIOLOGICAL WASTE WATER TREATMENT (Seibutsu Gakuteki Osui Shori Gijutsu ni Kansuru Saikin no Chiken),

Yamauchi, T., and Matsumoto, K.

Mitsubishi Juko Giho, Vol. 12, No. 1, p 118-124, January, 1975. 11 fig, 12 tab, 11 ref.

Various biological methods for waste water treatment have been developed. The most widely used biological method is the activated sludge process. A description is given of a new process for the treatment of waste water containing a high concentration of salt. One problem with activated sludge treatment is the development of bulking which prevents the waste water from being treated. In this case a trickling filter is required. A new process, the Mitsubishi BIO-PAC Process, has been developed for the treatment of waste water when bulking is a problem. The results of application of this new BIO-PAC Process are also discussed.

*Waste water treatment, *Biological treatment, *Activated sludge, *Trickling filters

*BIO-PAC Process

D302
IRON AND MANGANESE REMOVAL WITH OZONE. PART II,

Furgason, R. R., and Day, R. O.

Water and Sewage Works, Vol. 122, No. 7, p 61-63, July, 1975. 5 tab, 8 ref.

Iron and manganese removal using ozone oxidation was demonstrated in a pilot study at the Moscow, Idaho, municipal water system. Iron and manganese were effectively oxidized to an insoluble form which could be filtered from water. Raw water with iron and manganese concentrations of 9.5 and 1.2 mg/liter, respectively, was treated with ozone at a dosage of 8.8 mg/liter. This removed all the Fe and Mn to below Public Health Drinking Water Standards. At an ozone dosage of 6.3 mg/liter, the iron was removed, but a 0.1 mg/liter residue of Mn remained. Complete oxidation of both minerals involved a reaction time of 30 seconds. When compared to other methods, the capital investment costs of the ozone treatment were high, but the operating cost of $0.05/1000 gallons was competitively low.

*Ozone, *Municipal water, *Iron, *Manganese, Oxidation, Pilot plants, Water treatment, Potable water, Capital costs, Operating costs, Public health

Public Health Drinking Water Standards

D303
NUTRIENT REMOVAL IN BIOLOGICAL SYSTEMS,

Barnard, J. L.

National Institute for Water Research of the Council for
Scientific and Industrial Research,
Pretoria, South Africa.

Water Pollution Control, Vol. 74, No. 2, p 143-154, 1975. 11 fig, 1 tab, 24 ref.

Purely biological methods of nutrient removal are discussed. Removal of nutrients may be due to sludge synthesis or to wastage and the amount is dependent to a large degree on whether the assimilated nutrients in the waste cellular material are returned to the aeration basin. Fixed-media denitrification and suspended media denitrification systems are detailed. A modified activated sludge plant to remove nitrogen through nitrification/denitrification was developed, called the Bardenfo process. In this method, the need for methanol addition is eliminated but the basin size must be increased. Nitrates are used as a source of oxygen, and less sludge, which is more stable, is produced by a long solids retention time (SRT). If the Bardenfo method were applied to an extended aeration plant, costs would include partitions and an additional pump for recycling mixed liquor. These costs would be offset by savings in power due to no necessary increase in the basin size. Phosphorus precipitation in the final clarifiers of some activated sludge plants to which no chemicals have been added has been attributed to several factors. It seems that phosphate removal is greater with a low MLSS in the aeration basin and a low SRT. It has also been postulated that an increased pH is responsible for precipitation of phosphate. It was concluded that additional research is necessary to provide for better biological systems of nutrient removal without the use of expensive physico-chemical methods.

*Nutrient removal, Waste water treatment, Biological treatment, Nitrogen, Phosphorus, Nitrification, Denitrification, Activated sludge, Precipitation (chemical), Sludge treatment, Aeration

*Bardenfo process, Phosphate removal, Solids retention time (SRT), Physico-chemical treatment

D304
UNUSUAL FEATURES IN PLANT DESIGN,

Water and Sewage Works, Vol. 122, No. 6, p 80-81, June, 1975.

The city of Jackson, Alabama, has designed a new water purification plant, with a capacity of two mgd. The municipal water supply source is the Tombigbee River, along which industrial expansion is expected. The new industries--chemical and paper mills--will be expected to meet strict Alabama water pollution standards. The water treatment plant will have several unique features. Flocculators were designed for flexibility by building four units with vertical paddles, rather than a traditional two horizontal unit design. The LIGHTNIN model 34Q2 mixers with flocculating turbines also have variable speed control. River clarity changes often, and this variability is needed to keep solid particles properly suspended. Conical diffusers control the flocculating water as it enters the settling basin. Mud-laden water is trapped by these diffusers where the water loses velocity and dumps most of the mud at one end of the tank. A remote control panel is constructed and water conditions, from raw inflow to finished water, are automatically monitored.

*Water treatment, *Treatment facilities, *Municipal water, *Rivers, Water supply, Water purification, Flocculation, Monitoring, Automation, Control system

D305
PRIMARY DEVELOPMENTS OF AIR-BORNE BACTERIA IN THE OECD ACTIVATED SLUDGE SYSTEM,

Hitz, H. R., Plichta, G., Young, J. E. P., and Shewan, J. M.

CIBA-Geigy Limited,
Basle, Switzerland,
Dyestuffs and Chemical Division.

International Biodeterioration Bulletin, Vol. 11, No. 1, p 31-35, 1975. 4 fig, 1 tab, 23 ref.

The OECD Confirmatory Test Procedure is routinely used for testing the biodegradability of detergents in a modified Husmann Apparatus. It has been shown that the system does not need to be inoculated by bacteria from an outside treatment plant, but that the activated sludge can form its own flora by self-infection of air-borne bacteria. As an open continuous culture fermenter, the OECD system tends towards a "flow-balance" within the first 72 hours. The flow-balance is affected by physico-chemical and biological factors such as temperature, pH, nutrients, microbial antagonism, symbiosis, and metabiosis. More than half of the bacteria isolated and identified belonged to the genus Pseudomonas. The majority of the remaining bacteria were Bacillus spp. The results of the experiments were reproducible.

*Bacteria, *Activated sludge, Waste water treatment, Infection, Pseudomonas, Biodegradation, Detergents, Analytical techniques

OECD Confirmatory Test Procedure, Bacillus spp., Air-borne bacteria

D306
VIRUS REMOVALS IN TRICKLING FILTER PLANTS,

Sherman, V. R., Kawata, K., Olivieri, V. P., and Kaparstek, J. D.

Water and Sewage Works, Reference Number, p 36, 39-40, 42, 44, April 30, 1975. 2 fig, 4 tab, 19 ref.

A goal has been suggested of no more than one infectious virus particle per 10 gallons of receiving waters for waters used for contact recreation. Literature on the number of viruses found in waste water and on viral removal in sewage treatment gives conflicting information. An experiment was performed in order to assess viral removal efficiencies in two conventional trickling filter plants in Maryland. Plant capacities were 2.5 mgd and 1.5 mgd. The f2 bacterial virus was used as seed; plants were seeded to a high titer so that it would be possible to observe up to 99.999% removal efficiency. Little virus removal, as expected, occurred in the preliminary treatment units. In the primary sedimentation basins of the two plants, average virus removals were 32.2 and 37.1 percent. Through the trickling filter beds, average removal efficiencies were 18.9 and 9.0 percent for Plant No. 1 and Plant No. 2, respectively. In the secondary sedimentation basins, average virus removals were 30.1 and 28.4 percent. Consistent virus removal was achieved with chlorination, even when aqueous chlorine was simply introduced at the head of the chlorine contact basin through a diffuser. The chlorine contact units of each plant had average virus reductions of 60.7% and 59.4%. Overall virus reduction of the plants was 88.6% for Plant No. 1 and 85.2% for Plant No. 2. Thus, to meet the suggested goal of one virus particle per ten gallons, a greater efficiency in the disinfection process must be accomplished.

*Trickling filters, *Viruses, *Pollutant identification, Waste water treatment, Chlorination, Treatment facilities, Recreation facilities

*Viral removal

D307
PRINCIPLES AND TECHNIQUES FOR CONDITIONING OF WASTE-ACTIVATED SLUDGE BY DIRECT SLURRY FREEZING,

Khan, M. Z. A.

Virginia Polytechnic Institute and State University,
Blacksburg.

Dissertation Abstracts International B., Vol. 35, No. 12, Part 1, p 5922, 1975.

Direct slurry freeze conditioning of waste-activated sludge was shown to achieve a significant improvement in dewatering. Dewatering characteristics were defined by the specific resistance and coefficient of compressibility values, by settling, and by filter cake quality when vacuum filtration and gravity drainage on sand beds were used. Sludge samples were taken from plants treating domestic sewage, combined industrial wastes and domestic sewage, and pulp and paper wastes. Direct microscopic and wet sieve analysis indicated that the primary mechanism of conditioning was the promotion of flocculation by freezing. The degree of conditioning is a function of the "butane contact" or freezing time with better conditioning occurring with longer detention times. The direct slurry freezing process is more economical than other sludge conditioning processes such as indirect freezing and heat treatment. The estimated cost per ton of dry solids processed was $6-20.

*Waste water treatment, *Sludge treatment, *Freezing, Dewatering, Domestic wastes, Industrial wastes, Pulp and Paper industry, Filtration, Costs

D308
FACTORS AFFECTING OXYGEN TRANSFER DURING BUBBLE AERATION UNDER LABORATORY CONDITIONS,

Huang, C-Y.

Iowa University,
Iowa City.

Dissertation Abstracts International B., Vol. 35, No. 12, Part 1, p 5922, 1975.

Factors affecting oxygen transfer from air into liquid, such as inorganic electrolytes, suspended solids, and surface active agents, were studied in laboratory scale tanks. The effects were expressed by the alpha prime factor which is defined as the ratio of (K sub L)a in solution to (K sub L)a in demineralized water. The alpha prime factor increased in the electrolyte concentrations. The presence of suspended solids in the solution decreased the oxygen transfer rate. Significant decreases were observed with bentonite, asbestos fibers, and activated sludge. The combination of the additives produced a different effect as compared to the effect of the additives alone. A combination of the surface active agent and suspended solids produced a smaller decrease in the oxygen transfer rate than when either of the additives was present alone. The inorganic electrolyte increased the oxygen transfer rate but when it was present with the surface active agents, a larger decrease occurred. The effects of the additives were analyzed by considering the change of water molecular structure, hydrodynamics of the solution, and the interaction between the additives. The magnitude of the effect of each substance was not a simple function of substance or ionic concentration but also involved the orientation of water molecules and the nature of the substance. The saturated oxygen concentrations were also evaluated.

*Oxygen, *Waste water treatment, Suspended solids, Electrolytes, Surfactants, Dissolved oxygen, Oxygenation, Water treatment

*Oxygen transfer rate, Surface active agents

D309
PRIMARY SOLIDS/LIQUID SEPARATION,

Water Services, Vol. 79, No. 951, p 200-201, May, 1975. 1 fig.

A dissolved air flotation process has been designed for the primary solids/liquid separation stage necessary in the treatment of many potable and industrial waters and waste waters. Treatment is effected by air microbubbles which attach to the feed solids creating a positive buoyancy which causes the solids to float rapidly to the surface instead of settling slowly. The flotation process permits separation rates in the range from 8 to 11 cu m/sq m/hr so that smaller, more economical tanks than the usual settlement tanks can be constructed. The advantages of flotation include its adaptability to a wide range of applications, its flexibility in operation, and its rapid plant start-up and shut-down. Coagulation and flocculation are required for the effective removal of color and colloidal matter. The use of microbubbles in the flotation system produces a smaller floc which reduces the time needed for flocculation as compared to a settlement system. Compressed air is dissolved in a small quantity of recycled water at pressures at or above 4.0 atmospheres. The saturated air/water solution is released under controlled conditions in the flotation tank to produce a cloud of microbubbles which envelops the solids in the feed flow. Pilot plant studies using a pilot water treatment plant incorporating chemical treatment, flocculation, flotation, and filtration have substantiated the viability of flotation as a primary solids/liquid separation process. A typical process flow diagram for primary solids/liquid separation by flotation is presented.

*Flotation, *Waste water treatment, *Water treatment, Suspended solids, Pilot plants, Bubbles, Color, Flocculation

*Dissolved air flotation, *Solids removal

D310
CONTROL SYSTEM FOR SHOWA WATER PURIFICATION PLANT,

Harashima, Y., Watanabe, H., Komatsu, H., and Terauchi, Y.

Toshiba Rebyu, Vol. 30, No. 56, p 499-503, June, 1975. 12 fig, 1 tab.

The Showa Water Purification Plant, on the River Edo, Japan, is described. A facility with a water supply capacity of 350,000 cu m/day has been built in the Saitama Prefecture in order to meet an increase in water demand associated with urban growth and a decrease in groundwater resources from pumping. The treatment process involves precipitation, filtration, and sterilization. Computer control is implemented, with an option of chemical injection and control of the water flow. If the computer system is inoperable, a backup system of automatic analog control may be used. The facility has been in satisfactory operation for one year since its construction.

*Treatment facilities, *Water treatment, *Computers, *Filtration, *Precipitation (chemical), Urbanization, Water supply, Groundwater, Monitoring, Instrumentation

Chemical treatment, Japan

D311
GENERAL ASPECTS OF WATER SUPPLY AND TREATMENT IN ONTARIO,

Lumsden, T. W., and Knowles, W. L. C.

James F. MacLaren Limited, Environmental Consultants,
Willowdale, Ontario.

Canadian Journal of Civil Engineering, Vol. 2, No. 2, p 154-161, June, 1975.
2 fig, 3 tab, 8 ref.

The present state-of-the-art of water supply sources in Ontario, Canada, is reviewed. Within the province, water sources to be treated include the Great Lakes, southern Ontario rivers and groundwater, and northern rivers and lakes. Each area has its own set of problems of acquisition and treatment of water. Differences include hardness, turbidity, color, chemical composition, biological and bacteriological content. The effects of industrial expansion and urbanization are also discussed. Current trends in improvement of Great Lakes treatment facilities include pre-treatment with polymers, improving mixing and flocculation, adapting filters to high-rate service, and increasing hydraulic capacity of associated piping. River sources of potable water, particularly in southern Ontario, must be treated for turbidity, chlorides, hardness, dissolved solids, and for removal of algae and phenolic substances. Intensive treatment involves prechlorination; screening; superchlorination and dechlorination with ammonia and sulfur dioxide; taste and odor control with activated carbon; aeration; coagulation with alum and activated silica; pH control with calcium carbonate; sedimentation; filtration; postchlorination; postammoniation; and fluoridation. Groundwater obtained from aquifers in both northern and southern Ontario must be treated to remove entrained gases, which cause odor, taste, and corrosion problems. Aeration followed by filtration removes iron and manganese and the unwanted gases, while most well supplies are chlorinated. Further study is being conducted for advanced technology in chemistry, process control, and instrumentation.

*Reviews, *Water treatment, *Water supply, Great Lakes, Turbidity, Treatment facilities, Potable waters, Rivers, Groundwater, Aeration, Pre-treatment, Urbanization

*Ontario

D312
THE INFLUENCE OF OXYGEN CONCENTRATION AND TURBULENCE INTENSITY OF COMPLETE-MIX ACTIVATED SLUDGE PERFORMANCE,

Englande, A. J., Jr.

Vanderbilt University,
Nashville, Tennessee.

Dissertation Abstracts International B., Vol. 35, No. 12, Part 1, p 5921, 1975.

The relationships between oxygen concentration, turbulence intensity, and pertinent process parameters in a complete-mix activated sludge 10 gpm pilot plant treating a phenol waste water were studied. Bench-scale studies were conducted to determine the effect of other factors, such as food-to-microorganism ratio (F/M), the nature of the substrate, the nature of the turbulence, and solids concentration, on the floc size and consequently on the oxygen transfer efficiencies. Bench-scale models are capable of simulating prototype performance as expressed by kinetic substrate removal rate, oxygen uptake rate, floc size, and dehydrogenase activity. The substrate removal for the phenol sludge substantially decreased below a critical oxygen concentration of 0.5 mg/liter DO. Floc size was a function of the nature of the turbulence, the mixing intensity, the nature of the substrate, and the F/M loading. The scale of turbulence must be similar to that of the floc particles to influence floc size. A mixing intensity increase corresponded to a decrease in floc size. The flocs were essentially filament-free and their sizes were small enough so that oxygen diffusion could not be limiting. Two oxygen utilization rate monitoring methods, the DO probe and the off-gas analysis, produced the same results. The oxygen uptake test is an adequate substitute for monitoring bioactivity because of the observed linear relationship between dehydrogenase activity and DO uptake; both parameters increased in value with increasing loading rate.

*Waste water treatment, *Activated sludge, Mixing, Oxygenation, Phenols, Pilot plants, Laboratory tests, Oxygen requirements, Dissolved oxygen

D313
BREAKTHROUGH IN SEWAGE TREATMENT-A USER'S VIEW,

Eno, J.

Water, No. 4, p 18-19, July, 1975. 1 fig.

A pilot plant study of the deep shaft aeration process (developed by ICI) for effluent treatment is being conducted at the Billingham (Cleveland) sewage disposal works of the Northumbrian Water Authority. Operation started in July 1974; the pilot plant works in parallel with the main sewage treatment plant. Preliminary results suggest the need for further development to study plant parameters under variable operating conditions and on a larger scale before the system is generally accepted as a desirable alternative to conventional treatment methods. Of the claims by the manufacturer for this process, lowered sludge production and power consumption are the most important. With an appropriate balance of retention period, effluent substrate concentration, and degree of endogenous respiration, the treatment unit should produce a low quantity of well mineralized sludge. The cost of this goal needs to be evaluated in terms of process costs before any economical advantage can be determined. The claims of energy conservation, and therefore costs, must be compared with the economics of percolating filter plants. The relationship of construction costs to the biological kinetics of the process must be investigated. The interrelation of shaft diameter and construction costs becomes significant when the proposed plant size is between the practical limits of drilling and mining technology.

*Waste water treatment, *Treatment facilities, *Sewage treatment, *Costs, Economic efficiency, Energy conservation, Sludge

*Deep Shaft Process

D314
TREATMENT OF MUNICIPAL WASTEWATER BY LAND APPLICATION,

Pound, C. E., and Crites, R. W.

Metcalf and Eddy, Incorporated,
Palo Alto, California.

Water and Sewage Works, Reference Number, p R45, R48, R50, R53-54, R56, April 30, 1975. 1 fig, 7 tab, 23 ref.

A review is presented on the treatment of sewage effluents by land application. Research sponsored by various government agencies is being performed to gain a greater understanding of the ability of soil to treat waste water by physical, chemical, and biological means. Proper management and monitoring are required for successful land treatment systems. Land treatment can compete in many locations with advanced waste water treatment. Land treatment can be used in water pollution control systems in place of, in addition to, or in conjunction with conventional treatment methods. Topics covered in the review include: surveys; legislation; irrigation; overland flow; infiltration-percolation; waste water quality; and, cost of land treatment. Land treatment and recycling are encouraged by PL 92-500. Irrigation, the most commonly used land application method, is the application of water to the land to meet the growth needs of plants either by surface or spray application. Overland flow is a modification of spray irrigation to impermeable or poorly drained solids. In overland flow, a substantial portion of the waste water applied is designed to run off and must be collected and discharged to receiving waters or reused. Infiltration-percolation systems are characterized by percolation of the majority of the waste water through the soil to the groundwater and is restricted to rapidly permeable soils. Costs of land treatment systems will include the land, earthworks, pumping and transmission facilities, distribution systems, monitoring facilities, and for some systems, collection and storage facilites.

*Waste water disposal, *Waste water treatment, *Reviews, Soils, Irrigation, Overland flow, Infiltration, Groundwater, Costs, Legislation, Surveys, Water pollution control

D315
NEW CHLORINE APPLICATION IMPROVES VIRAL KILLS,

Water and Sewage Works, Reference Number, p R68-R70, R72, R74, April 30, 1975. 7 fig.

Disinfection of waste water by the direct application of raw chlorine gas has been accomplished by the use of a gas nozzle unit. The disinfection unit incorporates a double set of nozzles, one for motive flow and the other for disinfectant. Use of chlorine gas reduces the time required to effect bacterial kill. The major portion of the bacterial kill occurs almost immediately (within 3 seconds). The new disinfection process also shows high potential for virus inactivation. The pump, discharge manifold and jet nozzle of the disinfection unit are furnished completely assembled which makes installation of the equipment in an existing plant a relatively simple process. The pump is lowered into the chamber. Anchors are then placed in the floor and in the wall for mounting the retrieval guide bars for the pump and manifold assembly. Installation of the baffle and reactor tubes is the next step, followed by connection of the disinfectant feed pipes. The use of this injection process in several municipal treatment plants is discussed. The method of disinfectant introduction is critical to the kill efficiency. The more time the disinfectant has to react with species in the water, the less is its toxicity. This method injects molecular chlorine (the most reactive and toxic chlorine species) directly into the turbulent field, dispersing the disinfectant throughout the entire effluent flow. For a very short period, bacteria and viruses are subjected to an acutely toxic environment.

*Waste water treatment, *Disinfection, *Chlorination, *Pathogenic bacteria, Viruses, Bacteria, Sewage treatment, Equipment, Jets, Mixing, Public health

D316
WATER TREATMENT PLANT, CITY OF QUEBEC, CANADA,

Paquet, V.

Quebec City, Quebec, Canada,
Water Division.

Journal of the New England Water Works Association, Vol. 89, No. 2, p 111-120, June, 1975.

Treatment of water at the Quebec City Water Treatment Plant, Quebec, Canada, is described. Screening is performed through 8 mesh rotary screens at the water intake. Raw water is pumped into a pipe where chemicals, such as chlorine, alum, hydrated lime, and coagulant aids, are added to extract color and earthy materials. Mixing is aided by the use of helico-agitators. Water then overflows into ribbon type flocculators. The heavy floc formed settles easily in a settling tank. Treated water from the settling tanks flows into a water canal which feeds 16 filters which have a filtration capacity of 3 migpd. The filters are multi-layer type filters with gravel, sand, and anthracite. Filtered water is treated with ozone to eliminate tastes and odors. Prior to distribution, the water is neutralized with hydrated lime. Technical information is presented concerning nominal capacity, cost, electrical installation, mechanical installation, treatment, and, main characteristics of the water treatment plant.

*Water treatment, *Treatment facilities, Screens, Flocculation, Filtration, Ozone, Odors, Tastes, Neutralization, Coagulation, Lime, Chlorine, Mixing, Settling basins, Color

Mixed media filtration, Alum

D317
IMPROVEMENTS TO NEW BEDFORD'S WATER SUPPLY,

Begin, E. E., and Monk, R. D. G.

Water Department, New Bedford, Massachusetts.

Journal of the New England Water Works Association, Vol. 89, No. 2, p 145-160, June, 1975. 3 fig, 3 tab.

Improvements to the water supply of New Bedford, Massachusetts are necessitated by the fact that the old system has reached its limit of productivity. A decrease in water quality in recent years will be corrected by the construction of a treatment plant. The plant is designed to remove color, iron, manganese, taste, and odor. Chlorine disinfection and soda ash addition for corrosion control will be continued. A new raw water pipe will connect the existing transmission mains to the treatment plant. Pre-treatment will be performed in carbon contact, mixing and flocculation basins, followed by two-story sedimentation basins provided with mechanical sludge scrapers. The filters will consist of anthracite coal and sand, and have a filtration rate of 6 gpm/sq ft at 45 mgd. Alum and quicklime will be used for coagulation. Activated carbon will be used for taste and odor control. Potassium permanganate will be used as an oxidizing agent for the removal of iron and manganese. Total cost of the treatment plant will be $15.5 million. The municipal water reservoir has been covered. A new pumping station is designed to improve the existing high service facility. The main problem facing New Bedford is an inadequate water supply. Suggested plans for augmenting the supply are described. Completion of all phases of the improvement program will satisfy the requirements of New Bedford until the design year 2000.

*Water supply, *Water treatment, *Potable water, *Treatment facilities, Reservoirs, Water supply development, Water works, Water requirements, Water sources, Administration

New Bedford (Mass)

D318
A BREAKTHROUGH IN SEWAGE TREATMENT...AND THE MAKER'S VIEW,

Water, No. 4, p 19, 1975.

ICI's Agricultural Division has developed a revolutionary sewage process called the ICI Deep Shaft Effluent Treatment Process. A deep shaft partitioned into two sections and installed underground forms the basis of the process. Liquid effluent enters the shaft continuously and is circulated around the sections of the shaft repeatedly before overflowing by gravity for solids separation. Compressed air promotes biological oxidation and is the driving force for circulating the liquid effluent. The process should reduce future sewage works to half their normal size, operate them more cheaply, and produce only half of the normal amount of sludge. The process will also improve the environment by placing the major part of the treatment process underground and eliminating smell. The Deep Shaft process replaces the aeration and digestion stages of conventional sewage treatment processes. Considerable energy is saved by the exceptionally good use made of air's oxygen in the process. The depth of the shaft will determine the efficiency of the oxygen transfer. A deeper shaft will provide for more efficient oxygen transfer. The depth and diameter of the shaft will vary to meet the conditions of individual treatment plants. The problem of slow treatment rates in cold climates would also be reduced with the process.

*Waste water treatment, *Sewage treatment, *Treatment facilities, Energy conservation, Sludge, Economics, Costs, Biological treatment

*Deep Shaft Process

D319
WASTEWATER TREATMENT DESIGN: ECONOMICS AND TECHNIQUES, PART I,

Eckenfelder, W. W., Jr.

Vanderbilt University, Nashville, Tennessee.

Water and Sewage Works, Vol. 122, No. 6, p 63-65, June, 1975. 6 fig, 2 tab.

Specific waste water treatment design considerations are needed in order to economically meet the effluent limitations required by PL 92-500. The effluent quality from a waste water treatment facility will be related to the characteristics of the raw effluent and to the processes used in treatment. There are distinct and major differences between an industrial waste water and domestic sewage. In the treatment of domestic sewage by activated sludge, the colloidal and suspended BOD is bioflocculated and rapidly removed by a physical-chemical mechanism, while the soluble BOD is extracted slowly by a biochemical mechanism. Soluble industrial waste water requires biological BOD removal which is a function of time and concentration. A recently proposed kinetic model defines the performance of activated sludge treating variable strength soluble organic waste waters in terms of influent BOD, soluble effluent BOD, aeration volatile suspended solids, and aeration retention time. The implication of the model is that at a constant organic loading (F/M), the effluent soluble BOD is directly proportional to the influent BOD. Temperature affects the performance of the biological process, since the biodegradation rate is temperature dependent. The important temperature is the temperature in the aeration basin. A thermal balance must be figured considering the ambient air temperature and the influent waste water temperature. To determine the total BOD in the effluent, the contribution from the effluent by suspended solids must be added to the soluble BOD. Increasing the total dissolved solids in the waste water will generally result in an increase in effluent suspended solids.

*Waste water treatment, *Domestic wastes, *Industrial wastes, Activated sludge, Biological treatment, Biochemical oxygen demand, Temperature, Organic loading, Kinetics, Suspended solids, Biodegradation

D320
ECONOMIZING IN DESIGN WITHOUT SACRIFICING QUALITY,

Medlar, S.

Whitman and Howard, Incorporated,
Engineers and Architects,
Boston, Massachusetts.

Public Works, Vol. 106, No. 6, p 96-98, June, 1975. 3 fig.

A new 24 mgd water treatment facility is being built at Fall River, Massachusetts. Past water treatment had been chlorination and sodium hydroxide treatment and did not consistently provide water which met U. S. Public Health Service drinking water standards. The new filtration plant was designed so as to minimize construction and operating costs without sacrificing water quality. Treatment consists of flash mixing, flocculation, sedimentation, and rapid sand mixing; basins for the first three steps are built beneath the ground, so that tank roofs are a foundation for buildings housing equipment and an administration area. Water will flow by gravity from North Watuppa Pond to the treatment facility, where it is clarified. It is then distributed to rapid sand filters, which are of the automatic backwash type. After filtration, pH is adjusted for corrosion control, the water is chlorinated, and it enters a clear well to be pumped into the distribution system. Chemicals including liquid alum, liquid sodium hydroxide, chlorine gas, fluoride, polyelectrolyte, and powered activated carbon are fed automatically into the water, proportional to flow. A central control area, connected with alarm circuits to monitor key functions in the plant and the distribution system, is also described.

*Water treatment, *Potable water, *Treatment facilities, Filtration, Construction, Automation, Water distribution (applied), Water pollution control

Automatic backwash filters, Chemical treatment

D321
ALUM VS. PHOSPHATE—WASTEWATER TREATMENT,

Ockershausen, R. W.

Water and Sewage Works, Vol. 122, No. 7, p 80-81, July, 1975. 2 tabs.

Chemical treatment of municipal waste water is discussed. Of the types of coagulants used to remove phosphorus, alum is the most popular, found in 135 out of the 300 cities in this study. Chemical doses vary, dependent upon the pH of the water, colloids present and their electrical charges, pollutant load by waste discharges from industries, amount of groundwater infiltration, and temperature effects. Alum usage in activated sludge plants is compared with doses applied to treatment of raw waste water, and to doses in trickling filters. The lowest doses are needed in the activated sludge plants due to several factors: pH is lower due to CO2 release, which favors phosphorus removal and coagulation; degree and time of mixing can be controlled by moving the point of chemical addition in the aeration stage for maximum floc formation; and the recycle of activated sludge containing aluminum values from a previous addition aids in phosphorus removal, thus requiring less fresh chemical addition. Besides removing phosphorus, clarification by alum addition improves suspended solids and BOD removals. Capital costs of chemical treatment are low and operating costs are dependent upon the price of the chemicals.

*Nutrient removal, *Coagulation, *Waste water treatment, Activated sludge, Suspended solids, Biochemical oxygen demand, Phosphorus, Capital costs, Aluminum

*Alum, *Phosphorus removal, *Chemical treatment, Coagulants

D322
OZONE STIFLES SEWAGE ODORS IN RESIDENTIAL AREAS,

Baratt, M.

New York City Department of Water Resources,
New York, New York,
Structural Section.

The American City, Vol. 90, No. 8, p 54, August, 1975. 1 fig.

The Manhattan grit chamber treatment facility handles up to 110 mgd raw sewage from sewers and storm drains from the upper East Side of New York City. In the past, odorous air, containing hydrogen sulfide and other chemicals, was discharged from the chamber and vented out the roof. To eliminate the unwanted odors, treatment with ozone was chosen. Because the weight of a conventional ozone chamber of steel and concrete would be too much for the existing building housing the grit chamber, and because the steel and concrete labyrinth would be too expensive, it was necessary to choose another construction material for the maze. A system of fiberglass-reinforced polyester structural members with corrugated PVC panels was selected; structures of Extreen were employed, having dual properties of corrosion resistance and a high strength-to-weight ratio. New blowers were installed to deliver 67,800 cu ft of untreated air per minute to the ozone chamber. Horizontally corrugated PVC panels were extended from a light concrete plank floor up to the building roof and were arranged to form a 400 ft long labyrinth for ozone contact. Ozone may be produced on site at a rate of 17.5 lb/day and is mixed with polluted air with a 25 second contact time. Purified air is vented to the atmosphere through a louvered port, eliminating the undesirable odors to the city.

*Ozone, *Odor, Construction materials, Sewage treatment, Waste water treatment, Design criteria, Plastics, Treatment facilities, Corrosion control

Polyvinyl chloride

D323
EXPERIMENTS ON FLUID BED TREATMENT USING PETROLEUM-BASED SPHEROIDAL DUST COAL,

Atuta, S., and Mori, Y.

Journal of the Japan Water Works Association, No. 489, p 39-60, June, 1975. 50 fig, 16 tab, 4 ref.

Experiments have been made to solve an odor problem which occurs each spring and early summer at Isbanuma, the source of water for the Chiba Prefectural Waterworks Bureau, in Japan. Both laboratory studies and field surveys have been conducted. A recently developed method, using a fluid bed process with high fluidity activated charcoal, was very effective. This process was less expensive and easier to control than the conventional fixed bed process. The new fluid bed system is being tested on a pilot scale and initial results are detailed.

*Odor, *Activated carbon, Water treatment, Pilot plants, Treatment facilities

Fluid bed process, Charcoal, Japan

D324
POLYMER APPLICATIONS INCREASING IN WATER AND WASTE TREATMENT,

Herner, B. P.

Water and Pollution Control, Vol. 113, No. 7, p 13-14, July, 1975. 3 fig.

The mechanisms and applications of polymers for water and waste water treatment are discussed. The primary purpose of polymer use is to aid in liquid/solid separation processes. Polymers may be used both as primary coagulants and as coagulant aids, and have as a function to provide more complete separation, to increase hydraulic capacity of operating equipment, or to reduce the amount of chemical solids. The solids separation mechanism consists of coagulation, or charge neutralization and microfloc formation, and flocculation, or the physical agglomeration of the microfloc and entrapment of suspended solids. Polymers are long chain molecular structures, and may be anionic or cationic. For use in water clarification, liquid cationic polymers are useful because most naturally occurring solids suspended in water possess anionic surface charges in aqueous suspensions. The cationic polymers, by collision, bonding, and physical forces, cause the particles to coalesce to a size suitable for removal. Another application of polymers is in municipal pollution control plants as a replacement for lime or ferric chloride in sludge dewatering. Polymers are also used in other solids/liquids separation processes to aid in primary and secondary clarification, in elutriation, and in reduction of suspended solids in digester supernatant. For industrial wastes, polymers may be used for clarification, sedimentation, thickening, filtering, dissolved air flotation, and centrifugation in the paper, petrochemical, mining, refining, and manufacturing industries.

*Separation techniques, *Polymers, *Coagulation, Flocculation, Cations, Dewatering, Centrifugation, Filtration, Anions, Waste water treatment, Water treatment, Sludge treatment, Water pollution control, Industrial wastes

Petrochemicals, Clarification

D325
A NEW LOOK AT SEWERAGE AND SEWAGE DISPOSAL,

Chartered Municipal Engineer, Vol. 102, No. 6, p 51-59, June, 1975. 3 fig.

Issues presented at a seminar on "Modern practices in sewerage and sewage disposal", held in Birmingham, Great Britain, are discussed. Design criteria for a foul sewerage scheme were defined as concept, capacity, hydraulic design, structural design, and specification and construction. Storm sewage overflow problems were considered, and recommendations of a 6 DWF to be used for design of sewers and the minimum setting of weirs in overflow manholes were made. The discharge of industrial wastes was also reviewed, including the more biodegradable wastes, such as those from tanneries, farms, and textile industries; the strong, potentially harmful wastes from pharmaceutical, plastics, and petrochemical industries, and the toxic wastes, from chemical, oil, and metal industries. Treatments for each type were recommended. Description of some developments in sewage treatment involved the selection of appropriate standards for treated effluents, needs for seasonal treatment, such as in holiday campsites, and modifications in existing treatment facilities. Recovery of energy as methane from sludge digestion plants was suggested. Also, various equipment, including vacuum and pressure pump tankers, comminuters, and several pumps were described in detail.

*Sewerage, *Waste water treatment, *Sewage disposal, *Sewage treatment, Storm water, Overflows, Weirs, Industrial wastes, Textiles, Oil wastes, Methane, Treatment facilities, Pumps, Equipment

D326
NEW THERMAL PROCESS FOR PURIFYING WASTE WATERS,

Industrial Heating, Vol. 42, No. 7, p 32-34, July, 1975. 2 fig, 1 tab.

The Thermopure Process, developed at Laboratories of Aluminum Company of America (ALCOA), uses waste heat to purify industrial and sewage waste waters. Waste heat is used to concentrate waste products for reuse or simplified disposal and also produces deionized quality water that can be reused. A process description is given. The process employs conventional materials and established engineering technology and operates with low-pressure steam generated preferably by waste heat from various sources. Tests have been conducted using tap water, phosphate wastes, and a variety of oil wastes as feed materials. The thermal processing system is suitable for treating dilute salt wastes. Concentration of dilute acid or caustic wastes for reuse or sale is possible. Many types of oily wastes can be satisfactorily treated and can be reused after filtration. Dilute organic wastes are amenable to the process; the concentrated wastes can be reprocessed or incinerated. Advantages of the process include: production of deionized quality water; concentration of the original dilute waste to normal process levels makes reuse possible, and improves disposal; utilization of waste heat improves the economics of the process; the unit is suitable for unattended operation; and, based on the high quality water, reuse of concentrated waste, recovery of heat and elimination of high cost waste treatment, the process is most economical. The process can be used in a zero discharge system.

*Waste water treatment, *Industrial wastes, *Sewage treatment, Water reuse, Recycled water, Phosphates, Oil wastes, Organic compounds, Heat transfer, Conservation, Economics

Zero discharge

B327
WATER-DISINFECTION CHALLENGERS NOW ON TAP.

Ricci, L. J.

Chemical Engineering, Vol. 82, No. 17, p 49-51, August 18, 1975. 1 tab.

Possible health hazards from chlorination disinfection of water as a result of the reaction of chlorine residuals with organic contaminants have been revealed. As a result, alternative methods of water treatment, including ozonization and irradiation are being considered to remove the precursors of volatile organics. The advantages and disadvantages of activated carbon, ozone, alternative chemicals such as iodine, bromine, bromide chloride, and potassium permanganate, irradiation alone or with ozone, and ultraviolet radiation with ozone are discussed. Ozonization is the most successful alternative to chlorination and is widely used in France, West Germany, and Moscow for potable water treatment. While ozonization produces no chlorinated organics and provides good disinfection, its dosage must be carefully monitored for complete purification, as it leaves no residual for continued disinfection. In the United States, the first large scale ozone plant to treat waste water will be operating by next year to process 4 mgd in Southern Trumbell County, Ohio. Smaller facilities in Woodlands, Texas; Springfield, Missouri; Estes Park, Colorado; and Indiantown, Florida have chosen ozone for waste water disinfection.

*Water treatment, *Public health, *Ozone, Activated carbon, Potable water, Disinfection, Water purification, Treatment facilities, Irradiation, Waste water treatment

Chemical treatment, Ozonation, Chlorination alternatives

B328
CANADA PIONEERS LARGE-SCALE OZONE PLANTS.

Design Engineering, Vol. 21, No. 8, p 29-31, August, 1975. 1 fig.

Two very large scale ozone-based facilities are under construction in Canada. These are the Ashbridge Bay odor-control plant in Toronto and the Baillets filtration plant for water treatment in Montreal. In Ashbridge Bay, the primary odor source is sewage off-gases from the aeration tank. In order to oxidize these odorant gases, the tanks must be covered and ozone gas will then be introduced. Ozone will be generated, introduced into the chamber for contact, and monitored for proper dosage by an automatic control system which is adaptable to full computer control in the future. In the field of municipal water treatment the province of Quebec has already installed 21 ozone treatment facilities. By March 1976, the Baillets facility in Montreal will be the largest existing ozone-based water treatment plant. This facility will eventually treat 500 mgd to serve 88% of the Montreal urban population. The processes used will be filtration, ozonation, and chlorination; the ozone operation consists of pretreatment of the air, ozone generation, and ozone application. Ozonized air will be bubbled into the water at a depth of 24 feet and contacted for a sufficient time to produce an ozone residual of 0.4 mg/liter so that all bacteria and most viruses are destroyed.

*Ozone, *Waste water treatment, *Odor, *Sewage treatment, Municipal wastes, Canada, Treatment facilities, Computers, Control systems, Filtration, Chlorination, Viruses

Toronto (Canada), Montreal (Que)

D329
EXPERIMENTAL STUDY ON DIRECT COAGULATION FILTRATION METHOD
(Chohasetsu gyoshu roka-ho ni kansuru jikken kekka),

Tsunoda, S., and Aoyagi, Y.

Suido Kyokai Zasshi, No. 486, p 2-10, March, 1975. 14 fig, 3 tab, 18 ref.

The effect of pH on the filtration mechanisms in a direct coagulation filtration method was studied experimentally. An artificially turbid water was prepared by dissolving 20 ppm kaolinite into drinking water, adjusting the solution pH, adding polyaluminum chloride or aluminum sulfate as the coagulation agent, and filtering by a sand column. The zeta potential between the top of the sand column and 20 cm depth from the top was measured in relation to the solution pH or the filtration time. When polyaluminum chloride was employed as the coagulant, the optimum pH for the coagulation filtration occurred at 4 to 5. This is not in the pH range shown to be for the strongest coagulation force, and the mechanism of the removal of suspended particles by the sand at this pH range was the sand covering action. The mechanism for the solution with a pH of 6 to 9 was a blockade type, since the coagulation force between the suspended particles and coagulant was greater, resulting in the formation of larger particles. For the aluminum sulfate experiments, the optimum coagulation filtering occurred at a pH of 6 to 6.5 and the mechanism was the sand covering type; however, the mechanism for the solution with a pH above 7 was a blockade type and the leakage of coagulated particles from the sand column occurred in a short time. For both coagulants the kaolinite concentration in the column effluent decreased to less than one ppm for their optimum pH conditions.

*Filtration, *Coagulation, *Coagulation, Hydrogen ion concentration, Potable water, Water treatment

Filtration mechanisms

D330
EXPERIMENTAL STUDIES ON MECHANISM OF FILTRATION IN A
MULTILAYER FILTER,

Shinohara, O., and Ueda, T.

Journal of Japan Water Works Association, No. 489, p 2-38, June, 1975. 63 fig, 9 tab, 8 ref.

A review is presented of studies of filtration using multilayer filters. Comparisons are given of headloss, turbidity of filtered water, load factor of headloss at each depth, and effective filtration time for various filter systems. The mechanisms of filtration for a multilayer filter, including the production of micro-flocs and growth-flocs, are discussed. A determination of optimum values for floc properties, layer composition, and filtration speed may be made. Factors governing effective time are also detailed.

*Filtration, *Reviews, *Turbidity, *Waste water treatment, Kinetics, Hydraulics, Filters, Head loss

Japan, Multilayer filters

D331
AUTOGENUS INCINERATION OF SEWAGE SLUDGE NOW POSSIBLE,

Bowser, A.

Komline-Sanderson, Limited,
Brampton, Ontario, Canada.

Water and Pollution Control, Vol. 113, No. 7, p 17, 30-31, July, 1975. 3 fig, 1 tab.

Experimental studies on sludge dewaterability to a level high enough in combustible solids to be autogenously incinerated have been conducted at Hamilton, Ontario. Criteria for a conditioning agent are that it: should be cheap and readily available; have a high heat value, so that final solids concentration required for autogenous incineration is reduced; be able to combine with sludge to allow the mixture to give up its water easily; and, that it should handle easily, without hazards. A material which met these requirements was waste newsprint, which is readily dewaterable in a two-stage process of vacuum dewatering, followed by squeezing in a mechanical rotary press to a high solids concentration. It was found that pulped newsprint could be used to dewater waste activated sludge. Sludge needed to be first flocculated with a polymer, then mixed with the newsprint. A two-stage operation consisted of vacuum filtration to a filter cake of 13 to 15% solids (950 BTU/lb) which was then mechanically squeezed to the final product of 25-30% solids (1780 BTU/lb). Filter yield and final solids concentration of the product depend upon the relative amount of newsprint pulp added to the flocculated waste activated sludge. Further laboratory tests showed that raw primary and digested sludges may be similarly dewatered. Ferric chloride and lime conditioning were compared to this proposed use of polymer and newsprint pulp and the latter were seen to produce a sludge with less ash and, a cleaner filtrate, which was more amenable to autogenous incineration.

*Dewatering, *Waste water treatment, *Sludge treatment, Incineration, Polymers, Flocculation, Sludge disposal, Activated sludge

Autogenus incineration, Pulped newsprint, Vacuum filtration, Sludge conditioning, Waste activated sludge

D332
PLAN AND DESIGN OF SLUDGE TREATMENT FACILITIES OF NISHINAGASAWA PURIFICATION PLANT,

Nishizuka, M., Kudo, T., and Yamane, R.

Journal of Japan Water Works Association, No. 489, p 61-78, June, 1975. 9 fig, 14 tab, 5 ref.

Surveys and experiments were conducted by the Kanagawa Water Supply Authority to aid in choosing a system for the sludge treatment facilities of the Nishinagasawa Purification Plant. The system chosen was a combined granulation dehydration and drying system. The system became operable in April of 1974. A brief history of the decision to adopt the new system is given. The design of the system is also discussed.

*Water treatment, *Sludge treatment, *Water purification, Dewatering, Drying, Design, Treatment facilities

D333
EVAPOTRANSPIRATION POSSIBLE NEW SEWAGE TREATMENT PROCESS,

Journal of Environmental Health, Vol. 37, No. 5, p 476-477, March-April, 1975. 14 ref.

The use of evapotranspiration for treatment of sewage is discussed. Studies have been conducted in Ontario on the disposal of waste water by infiltration into the soil, whereby foliage of plants takes up water from the soil and it is evaporated into the air. By installing a shallow vented aerobic seepage bed and planting on top, plants use the wastes as food and water and aerobic microorganisms promote evaporation. In this on-site disposal method, uptake of nutrients by plants occur in the upper four to five feet of soil, and 95 to 97 percent of all pollutants and nutrients should be removed. For an evapotranspiration system (transvap), proper land management is necessary. To ease the load on the system: the ground surface above the bed should arch upward, promoting precipitation runoff; drainage and diversion trenches and grading should be utilized to shield the system from runoff; and shrubs and trees may be planted around the soil absorption area to add to the evapotranspiration capacity.

*Sewage treatment, *Evapotranspiration, Canada, Aerobic conditions, Microorganisms, Land management, Waste water treatment, Waste disposal

On-site disposal

D334
UPFLOW FILTER FOR POTABLE WATER PRODUCTION,

Haney, B. J., and Steinle, S. E.

Walk, Haydel and Associates, Incorporated,
New Orleans, Louisiana.

Journal of the Environmental Engineering Division, ASCE, Vol. 101, No. EE4, p 489-502, August, 1975. 6 fig, 4 tab, 33 ref, 1 append.

The operational reliability of a patented upflow filtration system (the L'Eau Claire Process) for the production of potable water was investigated. The upflow unit was subjected to upset conditions that are critical in both downflow and upflow filtration. The L'Eau Claire system with effluent disinfection was an effective self-contained means of potable water production. Turbidity removal was very good. Effluent averages were consistently below the American Water Works Association goal of 0.1 Jtu. Substantial coliform reduction occurred; average effluent levels were consistently below 50 coliforms/100 ml. The filter operated at filtration rates greater than 6 gpm/sq ft and as high as 10 gpm/sq ft. The L'Eau Claire system will react consistently to upset conditions. A loss of chemical upset will result in elevated effluent turbidity and coliform values 15 minutes after the loss of chemical. Values will increase until the chemical feed is resumed. Efficiency will not be reduced as a result of the loss and subsequent resumption of chemical. Increased effluent turbidity and coliform values will occur with an air injection upset. Values will peak in the first 15 minutes of the upset. Power failure upsets will be more critical at the beginning of the cycle than at the end. Surge upset will cause small increases in effluent turbidity and coliform values. Recovery from all upsets will occur 15 minutes after the upset condition is removed. The L'Eau Claire system can result in operational and capital costs savings.

*Potable water, *Water treatment, *Filtration, *Filters, Reliability, Operating costs, Efficiencies, Surges, Chemicals, Turbidity, Coliforms

D335
EFFECT OF MEDIA INTERMIXING ON DUAL MEDIA FILTRATION,

Cleasby, J. L., and Sejkora, G. D.

Iowa State University,
Ames,
Department of Civil Engineering.

Journal of the Environmental Engineering Division, ASCE, Vol. 101, No. EE4, p 503-516, August, 1975.

Dual media filters composed of anthracite coal over silica sand are widely used in water and waste water treatment. A study was performed to determine if intermixing at the interface of the rediums has any effect on the performance of dual media filters. Performance differences were shown by measurements of headloss development and effluent quality versus time during filtration. Interfacial intermixing did not affect filter performance as measured by both headloss development and effluent quality of dual media filters. The mixed interface filter media produced a higher quality filtrate than did the sharp interface filter media. This was due to substantially finer sand in the mixed interface media. The mixed interface filter media produced higher headlosses than the sharp interface filter media because of the greater suspended solids removal. Intermixing at the interface of dual media filters is unavoidable. It occurs when current media materials are used and sizes are selected to achieve coarse to fine filter media in the direction of flow. A reasonable amount of interfacial intermixing is desirable in dual and multimedia filters to achieve a better quality filtrate.

*Waste water treatment, *Water treatment, *Filtration, *Filters, Coals, Sands, Interfaces, Mixing, Efficiencies, Water quality

*Dual media filters, Media intermixing, Anthracite coal, Silica sand

D336
WASTEWATER TREATMENT DESIGN, PART II,

Eckenfelder, W. W., Jr.

Vanderbilt University, Nashville, Tennessee.

Water and Sewage Works, Vol. 122, No. 7, p 70, 75, July, 1975. 2 fig, 1 tab, 3 ref.

Increasingly strict water quality standards require combinations of biological, physical and chemical treatment processes. Physical-chemical processes may be used for independent physical-chemical treatment of domestic sewage and certain industrial waste waters or for tertiary treatment following biological treatment processes. Physical-chemical treatment, consisting of pretreatment, chemical coagulation employing lime, iron salts or alum, followed by granular carbon columns, is highly effective for the treatment of domestic sewage. The treatment of industrial waste waters containing high concentrations of soluble organics creates several problems in physical-chemical treatment. These can most effectively be treated by a combination of biological, physical and chemical processes. A number of possible process combinations are discussed; these may include the addition of powdered activated carbon to the activated sludge process or the use of mixed media filters. Various process combinations that might be used to achieve high quality effluents are presented. The main parameters considered in the combinations include: the BOD removal rate coefficient, k; the COD to BOD ratio; and, the total dissolved solids in the waste water. When the BOD reaction rate coefficient, k, is very low, very long aeration times are required to reduce the soluble BOD to levels of 10 mg/liter or less. Cost relationships, in terms of k and soluble effluent BOD, are graphically portrayed. Temperature has an important effect on the performance of biological waste water treatment processes.

*Waste water treatment, *Industrial wastes, *Domestic wastes, Design, Biological treatment, Water quality control, Pre-treatment, Coagulation, Activated carbon, Activated sludge, Biochemical oxygen demand, Chemical oxygen demand

*Physico-chemical treatment

D337
HIGH-RATE WATER TREATMENT: THE STATE-OF-THE-ART,

King, P. H., Johnson, R. L., Randall, C. W., and Rehberger, G. W.

Virginia Polytechnic Institute and State University,
Blacksburg.

Journal of the Environmental Engineering Division, ASCE, Vol. 101, No. EE4, p 479-488, August, 1975. 4 fig, 9 tab, 5 ref, 1 append.

One of the major advances in water treatment technology has been the application of processes operating at substantially higher hydraulic loading rates than previously used. A survey was recently conducted by the ASCE-EED Committee on Water Purification of state regulatory agencies to determine the prevailing concept of high-rate water treatment and to determine their attitude toward the various methods presently used. Treatment processes considered include flash mixing and flocculation units, sedimentation basins, filtration, and softening. The large majority of the states which responded indicated favorable experience with high-rate treatment plants. Operating data from four high-rate water treatment plants in Virginia were studied. The water produced by each of these plants was consistently of high quality; no significant turbidity breakthrough occurred during the study. The Committee has concluded that a broader based concept of high-rate treatment that includes other units as well as filtration units needs to be developed. When designing a water treatment plant, the entire system, from rapid mix to final stabilization and disinfection, should be considered as a single entity to obtain the optimum and most economical solution for each plant. High-rate treatment should include realistic loadings on flash mixing, flocculation, and sedimentation basins, and on solids contact units as well as filtration units. The Committee concludes that there are economic advantages in high-rate treatment processes which can be gained without sacrificing the quality of the water produced.

*Water treatment, *Filtration, *Hydraulic design, Economics, Water quality control, Treatment facilities, Virginia, Mixing, Flocculation, Sedimentation, Water softening

High-rate treatment processes, ASCE-EED Committee on Water Purification, Hydraulic loading rates

D338
FILTER PLANT MODIFICATIONS FEATURE WASTEWATER RECOVERY,

Weaver, J. H.

Robert and Company Associates,
West Palm Beach, Florida.

Public Works, Vol. 106, No. 8, p 66-68, August, 1975. 6 fig.

Although the City of Tampa, Florida, is involved in a long range study of expanding its water capacity, it was decided that immediate steps should be taken to avoid problems in the event of prolonged periods of dry weather within the next two or three years. Three areas were identified that could provide quick solutions at the lowest cost: the potential raw water supply could be increased by lowering the reservoir intake; the direct loss of water from the system caused by wasting filter backwash into the river could be eliminated; and, the storage capacity and processing volume of the settling basins could be increased by modification of existing basins and building two new ones plus modification of filters. A new reservoir intake was installed about 5.5 feet below the level of the existing intake, adding about 572 million gallons of usable capacity. Improvements to the intake system included: trash rakes to remove debris from the trash bars; travelling water screens to remove finer particles not collected by the bars; and, vertical pumps that do not need priming. To increase the time between backwashing operations, all filters were converted to dual media (anthracite coal and sand). The duration of filter runs has been increased about 50%. The minimum hydraulic capacity has been increased from 2 gpm/sq ft to 3 gpm/sq ft. The filter backwash is now collected in an equalization basin and recycled into the system. Some of the older existing settling basins had a loss of capacity due to the build up of sludge deposits on the bottom. Mechanical sludge collectors were installed. These move continuously across the bottom of the basin, collecting sludge at one end where it is pumped to drying beds or into the sanitary sewer.

*Water treatment, *Treatment facilities, *Water supply, Reservoirs, Water shortage, Water storage, Screens, Filters

D339
NEW WATERWORKS IN STOCKHOLM,

Baeckstroem, K.

ASEA Journal, Vol. 48, No. 2, p 27-34, 1975. 13 fig.

A brief description is presented of the electrical power, process control, and computer equipment for the new East Norsborg Waterworks in Stockholm, Sweden. In the first stage, the waterworks has a capacity of 200,000 cu m/day, which will eventually be doubled. This is the first waterworks in Sweden to operate with an electronic operating system and computer control. Equipment for the power supply includes: switch gear; automatic change-over system; and power-factor correction. The speed of the raw water pump motors is controlled by means of three thyristor convertor cascades. The main control board is built from mosaic modules and includes the necessary instrumentation, controls, signalling devices, and mimic diagrams. Units for the electronic control of different process components include: operating and indicating modules; operating and indicating printed-circuit boards; and, motor starter groups in the switch-gear. The operating system incorporates integrated fault annunciator equipment; each fault is identified as to which object is faulty and what the type of fault is. To reduce the amount of work involved and speed up the restarting time, an automatic zero voltage system is provided which ensures that in the event of a loss of voltage certain valves are set to the positions which they should occupy during start-up. Rapid sand filters and aluminum sulfate dosage control systems are discussed. Automatic measuring systems monitor flow, pressure, level, energy, weight, concentration, turbidity, and pH. The computer system is responsible for data acquisition, processing, storage, logging, process control, monitoring, alarms, and statistical processes.

*Water treatment, *Treatment facilities, Automatic control, Control systems, Computers, Equipment, Instrumentation, Power operation and maintenance, Power system operation, Electric power, Electrical equipment

*Stockholm, Sweden

D340
PARTICLES, POLYMERS, AND PERFORMANCE IN FILTRATION,

Habibian, M. R., and O'Melia, C. R.

Qumta Consulting Engineers, Tehran, Iran.

Journal of the Environmental Engineering Division, ASCE, Vol. 101, No. EE4, p 567-583, August, 1975. 9 fig, 2 tab, 24 ref, 2 append.

The results of laboratory experiments concerned with the effects of polymers on the removal of particles from aqueous suspensions by packed-bed filters are discussed. The rationale for developing and interpreting the experiments is that coagulation and filtration are quite similar processes. Based on results using cationic polymers for the filtration of latex suspensions and trickling filter effluent, it is concluded that the chemical destabilization necessary for effective filtration is similar to that required for effective coagulation. Chemicals which are effective in coagulation are also effective in filtration. The optimum dose of a destabilizing chemical in filtration is the same as the optimum dose in coagulation. Standard jar (coagulation) tests can be used to determine the type and amount of chemical needed for destabilization in filtration. Overdosing and stoichiometry occur in polymer-aided filtration as well as in polymeric coagulation. The optimum polymer dosage was independent of the molecular weight of the cationic polymer series tested (polyethylenimenes), except for the lowest polymer in the series. The removal efficiency of filters operated at the optimum dosage increased with increasing molecular weight of the polymer employed. For a properly conditioned filter, the filter efficiency is independent of the concentration of suspended materials in the influent. This makes the direct filtration of low-turbidity water technologically feasible. The head loss within a filter bed varies inversely with the size of the particles removed from the suspension.

*Filtration, *Laboratory tests, Waste water treatment, Water treatment, Polymers, Coagulation, Separation techniques, Packed beds, Particles

D341
IRRADIATION OF SEWAGE GAINS ADHERENTS,

O'Sullivan, D. A.

Chemical and Engineering News, Vol. 53, No. 34, p 30-31, August 25, 1975.

The progress of the use of irradiation for sewage and waste water treatment is discussed. A pilot plant is being installed at Boston's (Mass) Deer Island sewage treatment plant to test the effectiveness of electron beam irradiation in treating municipal sewage. A pilot system is being planned for Fort Belvoir, Va. Tests will examine the feasibility of replacing the secondary treatment with irradiation and will evaluate the use of the resulting sludge as fertilizer. The pilot will use cobalt-60 and then switch to cesium-137 when it becomes more widely available as a waste product from nuclear power plants. Cesium-137 is the preferred radioisotope being studied at Sandia Laboratories in Albuquerque, N.M. Engineers at International Purification Systems Inc., in Atlanta, Ga., are working on a waste water purification system that uses gamma irradiation to regenerate a charcoal adsorbent bed continually. A new treatment system for Monticello, Fla., will involve irradiation to pasteurize waste water from the sewage works so that it can be used safely for irrigation. Engineers at Aqueonic Inc., in Los Altos, Calif., have developed the Biochemrad system which combines primary, secondary, and tertiary sewage treatment in a multistage design. The first commercial sewage irradiation operation started in West Germany in 1973. Currently it is questioned as to whether radioactive isotopes or high energy electron beams are the preferred method of sewage purification. The reasons for either choice are discussed.

*Waste water treatment, *Irradiation, Gamma rays, Radioisotopes, Cobalt radioisotopes, Cesium, Sewage treatment, Irrigation, Fertilization, Sewage disposal, Radioactive wastes

Electron beam irradiation

D342
FINAL ENVIRONMENTAL IMPACT STATEMENT, UPGRADING AND EXPANSION OF THE WSCC PISCATAWAY WASTEWATER TREATMENT FACILITY TO 30 MGD AWT, PRINCE GEORGE'S COUNTY, MARYLAND,

Environmental Protection Agency, Region III,
Philadelphia, Pennsylvania.

September 16, 1974. 824 p, 23 fig, 25 tab, 12 photos, 11 append.

The Washington Surbuban Sanitary Commission (WSSC) has applied to the Environmental Protection Agency for federal financial assistance to upgrade the Piscataway Wastewater Treatment Facility to provide advanced waste water treatment (AWT) and to operate at its full 30 mgd capacity. The final environmental impact statement report is presented. The proposed project is an integral portion of a comprehensive program designed to clean up the lower Potomac River and its tributaries. This project would improve water quality in the tributaries to Piscataway Bay. The facility will fulfill the goals of water pollution control without significantly harming other environmental criteria, and will aid in providing a cleaner, healthier environment. The adverse environmental impacts created by the implementation of this program are largely short-term and within acceptable limits. The adverse impacts are associated with construction activities and would result in temporary increased noise levels, disruption of traffic, inconveniences to residents, siltration of streams, disruption to wildlife and wildlife habitat, and slight decreases in ambient air quality in areas close to the construction. The size of the effluent disposal pipe and the proposed method of sludge treatment and disposal are two areas of controversy. The disposal pipe has a larger capacity than is currently required but this is allowable because it eliminates the necessity for replacing the pipe if the capacity of the plant is increased in the future. The proposed method of disposal, incineration, is still under investigation. Incineration will not be allowed on a routine basis until its environmental effects are known.

*Waste water treatment, *Treatment facilities, *Environmental effects, Incineration, Environmental control, Environmental engineering

D343
STUDIES ON THE METALLIC ION STIMULATION AND TOXICITY IN SLUDGE DIGESTION,

Savalappan, K. N.

Dorr-Oliver (India) Limited,
Madras, India.

Journal of the Institution of Engineers (India), Vol. 55, Part PH 2, p 51-54, February, 1975. 12 ref.

Anaerobic sludge digestion is the anaerobic decomposition of putrescible matter accompanied by gasification, liquefaction, stabilization, and destruction of colloidal structure. The purposes of sludge digestion include: altering the water binding characteristics so that rapid dewatering will result; reducing the initial bulk for economical solids handling; destroying pathogenic organisms for health protection; stabilizing a sufficient fraction of the organic solids so that noxious odors are not produced; and, recovering the methane gas and digested sludge as usable by-products. The three important factors in the process of sludge digestion are the digestion tank, the sewage sludge, and the bacteria. After the sludge is sent to the digestion tank, the organic materials, contained mostly in the solid portion of the sludge, are slowly hydrolized and brought into solution by the bacteria and the enzymes present in the sewage sludge. The importance of enzymes in digestion was discussed. The nutritional requirements of the sewage bacteria were also discussed. An organism in general requires: a source of nitrogen; a source of carbon; inorganic salts; and, a source of energy. It can be assumed that a bacterium will not grow well in the complete absence of all mineral elements. The function of metal ions in bacterial nutrition is similar to the role played by vitamins in human nutrition. The study of the effects of various cations on sludge digestion is extremely important. Stimulation was defined as an increase in the biochemical activity of bacteria over the normal activity due to the addition of any substance. Toxicity or inhibition was a decrease in the biochemical activity.

*Waste water treatment, *Sludge treatment, *Sludge digestion, *Anaerobic digestion, Metals, Sewage sludge, Bacteria, Anaerobic bacteria, Biological treatment, Nutrients, Toxicity, Methane bacteria

D344
INTERIM REPORT ON TASK FORCE ON PHOSPHATE REMOVAL SLUDGES,

Farrell, J. B.

National Environmental Research Center, Office of Research and Development, EPA, Cincinnati, Ohio, Advanced Waste Treatment Research Laboratory.

EPA-670/2-75-013, January, 1975. 200 p, 1 fig, 2 tab, 15 ref, 10 append.

A substantial portion of waste water treatment capital and operating cost is due to sludge handling and disposal. However, information on sludge produced in conventional waste water treatment is widely scattered and very little information is available on the sludges produced by processes for phosphorus removal. An interim report of a task force on the sludges produced when lime, Fe(+++), or Al(+++) are added for the purpose of P removal is discussed. Data are presented on the thickening and dewatering characteristics of these sludges. Most of the information concerns the mass of sludge produced and its filtering properties. The sludges formed when lime is added to waste water have a greater solids content after settling and dewater at greater mass rates than conventional sludges. Conventional sludges are defined as digested total sludge from a conventional primary plus activated sludge plant. Lime sludges produce a much larger mass of sludge per volume of waste water. Sludges formed when Al(+++) or Fe(+++) are added to waste water dewater more poorly than conventional sludges and the sludge solids content is less. The sludge mass produced is higher than that from conventional sludge but lower than that from lime sludges. Sufficient information is not yet available to accurately predict the dewatering properties of iron or aluminum sludges. Research studies and field investigations of the dewatering properties of iron and aluminum sludges are being continued.

*Sludge treatment, *Sludge disposal, *Dewatering, *Filtration, Phosphorus, Phosphates, Iron, Aluminum, Lime, Solid wastes

Sludge volume, Thickening

D345
A LABORATORY STUDY OF RDX ADSORPTION BY CARBON,

Vlahakis, J. G.

U. S. Army Mobility Equipment Research and Development Center,
Fort Belvoir, Virginia.

August, 1974. 37 p, 18 fig, 4 tab, 2 append. ADA 002 049.

A two-phase study was performed to investigate treatment methods for the removal of RDX explosive ($C_3H_6O_6N_6$) from contaminated groundwater. The first phase of the program consisted of testing seven different commercially available processes: carbon adsorption; reverse osmosis; ion exchange; hydrolysis; boiling; chlorination; and, polymeric adsorption. Carbon adsorption represented the best process for removal of RDX from potable water based on relative simplicity and effectiveness for domestic use. Adsorption isotherm tests indicate that the maximum theoretical saturation capacity of Filtrasorb 400 is about 0.125 g RDX/g carbon for a feed concentration of 19.5 mg/liter RDX. When about 60 mg/liter TNT were added to the RDX feed, the RDX saturation capacity was reduced 40% to 0.076 g RDX/g carbon. The second phase of the investigation consisted of running small-diameter-column exhaustion tests using Filtrasorb 400 to determine residence times, carbon capacities, and breakthrough characteristics of the carbon under dynamic conditions. Retention times of 0.92 to 4.90 minutes were studied. For five runs with flow rates ranging from 0.36 to 1.5 gal/min/sq ft and feed concentrations from 5.5 to 20.4 mg/liter RDX, the adsorption efficiency was directly related to retention time. In competitive adsorption of TNT and RDX, the RDX adsorption efficiency was dependent on the RDX to TNT concentration ratio over a narrow RDX concentration range. This is due to the preferential adsorption of TNT. Additional research should be performed to investigate a wider range of the experimental parameters in order to facilitate scale-up.

*Water treatment, *Adsorption, *Carbon, Activated carbon, Groundwater, Explosives, Potable water, Reverse osmosis, Ion exchange, Hydrolysis, Chlorination, Polymers, Boiling

*RDX, TNT, Filtrasorb 400

D346
REMOVAL OF f2 VIRUS FROM RIVER WATER BY ARMY WATER PURIFICATION UNITS,

Ford, A., Jr., and Pressman, M.

Military Technology Department, MERDC,
Fort Belvoir, Virginia,
Sanitary Sciences Division.

U. S. Army Report No. 2109, August, 1974. 24 p, 3 fig, 10 tab.

A field study was conducted at Fort Meade, Maryland, to investigate the capabilities of two water purification systems in removing coliform organisms and f2 bacteriophage from the water of the Little Patuxent River. These purification systems were a prototype, 360 gph reverse osmosis water purification unit and a standard, 420 gph, water purification unit. From data gathered, it was concluded that both the prototype and the standard water purification unit were capable of effectively reducing the concentrations in a natural water of coliform organisms and f2 virus to undetectable levels. The prototype reverse osmosis unit operated with cationic polyelectrolyte addition, prefiltration, and hypochlorination and the standard unit employed coagulation, diatomite filtration, and hypochlorination. Additionally, it was found that dual-media pressure filtration at ten gal/min/sq ft, with cationic polyelectrolyte addition, used as pre-treatment with the reverse osmosis unit, was capable of removing 99.99% of an added f2 virus from a natural water. Virus removal in this operation was the same after filter rinsing and following backwash with either clarified or raw river water.

*Water purification, *Rivers, *Reverse osomosis, Polyelectrolytes, Viruses, Water treatment, Filtration, Coagulation, Data collection, Coliforms, Pre-treatment

f2 virus, Pressure filtration

D347
A PILOT PLANT FOR SEWAGE TREATMENT BY CROSS-FLOW FILTRATION,

Perona, J. J., Hutchins, J. D., Rom, A. M., Johnson, J. S., Jr., and Sisson, W. G.

Oak Ridge National Laboratory Report No. ORNL-TM-4659, September, 1974. 20 p, 6 fig, 1 tab, 1 ref.

The first six months of operation of a 10,000 gpd pilot plant for treating primary sewage effluent from the Oak Ridge municipal plant have been successful. The plant operates by physico-chemical treatment, without biological action, and is based on the cross-flow filtration process. This process consists of acidification to pH 3 and addition of iron; holdup with air sparging for one hour; pH adjustment to 6; and filtration. Five runs were made with product fluxes above 100 gal/day cu ft for the first 50 hours of operation. Chemical and power costs for a large scale process would be in the range of 35 to 60 cents/gal. Effluent was taken from a primary settler as feed and produced a filtrate of a higher quality than that obtained by secondary biological treatment. Because the present filter design would not be applicable for a large scale plant, it is recommended that a filter development program be conducted to implement this method.

*Sewage treatment, *Pilot plants, *Waste water treatment, *Treatment facilities, Municipal wastes, Alkalinity, Filtration, Filters, Effluents

Cross-flow filtration, Physico-chemical treatment

D348
EVALUATION OF A 35-GPH PORTABLE DESALINATION PLANT AND CONCEPTUAL DESIGN OF A 220-GPH CONTAINERIZED PLANT,

King, J. C.

Naval Facilities Engineering Command Report No. TM-1370, January, 1975. 22 p, 8 fig, 2 append.

The performance of a mobile water desalination plant to be used for Navy bases was tested. The Model D-20 Watermaker plant is suitable for temporary use as a portable, self-contained unit to supply water immediately after field forces establish a beachhead. The plant was operated for over 2000 hours. The unit has a low product-to-fuel ratio (10-to-1) and operates with an oil-fired boiler as its heat source. Raw seawater is distilled in a vacuum of about 25 inches mercury, which lowers the boiling point of water to between 115 F and 130 F, operating temperatures low enough to minimize scale formation. Raw water is distributed through four circuits to: provide a source of raw water for evaporation into distilled vapor; cool the upper heat exchanger which condenses the distilled vapor to fresh water; give power to the jet pump which creates a vacuum in the distillation chamber; and, provide power for the jet pump to discharge brine from the distillation chamber. A conceptual design has been prepared for a 220-gph plant that can be fully self-contained in a standard 8 X 8 X 20-foot container.

*Desalination apparatus, *Desalination plants, *Water treatment, *Potable water, Water supply, Sea water, Fresh water

Mobile water desalination plant

D349
TREATMENT OF SLUDGE FROM SEWERAGE AND BURNT ASHES,

Yanagi, F.

Japan Patent Agency, EPA-TR-24 73, August 15, 1966. 7 p, 1 fig.

An application for a patent to treat sludge from sewerage and burnt ashes has been filed. The method of treatment of ash and exhaust gas from the burning of dehydrated sludge solids is detailed. The burned ash will be divided into a portion containing iron compounds and one containing calcium, and these will be collected for reuse as precipitates. The steps of filter dehydration and burning of the sludge are combined into one process in this invention. A diagram of the procedures is provided for graphic illustration.

*Patents, *Sludge treatment, *Dehydration, *Incineration, Precipitation (chemical), Sewerage, Waste disposal, Sludge disposal

D350
ELECTROCHEMICAL CARBON REGENERATION,

Owen, P. H., and Barry, J. P.

Environics, Incorporated,
Huntington Beach, California.

June, 1972. 43 p, 10 fig. PB 239 156.

Experimentation was conducted to investigate a process of electrochemical regeneration of granulated activated carbon spent in the adsorption treatment of municipal secondary effluent. Electrochemically regenerated carbon and virgin carbon were compared by their respective abilities to remove soluble COD organics from sand-filtered secondary effluents during simultaneous dynamic exhaustion. It was found that electrochemical regeneration of granular activated carbon can restore the working capacity for removing soluble COD organics to from 42 to 61% of the capacity of virgin carbon. The 61% of COD capacity electrochemically regenerated is about 77% as good as the average thermal regenerated capacity. As compared to thermal regeneration of carbon, the costs of electrochemical regeneration are much lower. Based on the electrolysis cell energy requirement measured as 15.3 watt hours per gram COD adsorption capacity regenerated, the calculated cost of electrical power to regenerate and rinse the carbon spent in treating 1000 gallons of Lake Tahoe-type waste water was 0.66 cents. This is equivalent to 3.2 cents per pound of carbon at a dosage of 207 lbs carbon per million gallons of effluent.

*Adsorption, *Activated carbon, Waste water treatment, Municipal wastes, Effluents, Tertiary treatment, Electrochemistry, Water purification, Chemical oxygen demand, Costs, Sewage treatment

*Electrochemical regeneration, Thermal regeneration, Regenerated carbons

D351
AN EVALUATION OF THREE COMBINED SEWER OVERFLOW TREATMENT ALTERNATIVES,

Parks, J. W.

Clark, Dietz, and Associates-Engineers, Incorporated,
Urbana, Illinois.

December, 1974. 112 p, 32 fig, 20 tab, 2 append. PB 239 115.

Three systems for the treatment of combined sewer overflow in Shelbyville, Illinois were evaluated for influent and effluent flow, BOD, and suspended solids. These were a single-cell flow-through lagoon, a retention lagoon followed by a two-cell facultative lagoon system and effluent chlorination, and a sedimentation tank with influent chlorination. Each alternative unit was found to be effective in reducing the measured pollutional discharges during wet weather conditions. Partial separation of the combined sewers also was successful in reducing the organic loading during periods of combined sewer overflow. A detailed analysis was presented of the two-cell facultative lagoon as a tertiary treatment system for the existing sewage treatment plant effluent. Data on the operation of the units was collected only during April and May, and it was recommended that these treatment units be further tested for seasonal variation in runoff which might affect unit performance. Design criteria in selecting and sizing combined sewer overflow treatment units should be based on the expected first flush characteristics, runoff intensities, and influent sewer hydraulic capacities.

*Waste water treatment, *Sewers, *Overflow, *Combined sewers, *Treatment facilities, Sewerage, Biochemical oxygen demand, Suspended solids, Effluents, Organic matter, Lagoons, Data collections, Hydraulics, Storm runoff

Wet weather discharge, Organic loading

D352
UV-OZONE OXIDATION/STERILIZATION PROCESS,

Zeff, J. D., Barton, R. R., Smiley, B., and Alhadeff, E.

Westgate Research Corporation,
Marina del Rey, California.

September, 1974. 89 p, 4 fig, 31 tab, 19 ref, 4 append. ADA 004 205.

It has been found that the combination of ozone and ultraviolet radiation for purifying water containing bacteria and organics is more effective than either treatment alone. A study was conducted to determine the levels of ozone and UV radiation required to destroy predetermined concentrations of microbial contaminants and organic substances in waste water effluents. A stirred batch reactor was used for both a microbiological and an organic study. The microbiological investigation on E. coli, Streptococcus faecalis, Klebsiella pneumonia and Acanthamoeba castellanii showed that the rate of destruction at room temperature and at 40 C were about the same. Approximately 0.3 mg/liter of ozone in water was effective in the presence of uv light for two minutes or more contact time for disinfection. Test organic compounds selected were hydroquinone, pyrogallol, xylenol, sodium acetate, and urea. A column reactor with an internally located uv lamp gave the best reaction rate and ozone in air plus uv at ambient temperature and pressure gave good results.

*Ozone, *Ultraviolet radiation, *Waste water treatment, Organic matter, Microorganisms, Bacteria, Effluents, Temperature, Pressure, Disinfection

D353
STUDIES ON USE OF FLYASH IN CONJUNCTION WITH ALUM FOR COAGULATION OF TURBID WATER,

Adhikari, M., Gupta, S. K., and Biswas, R. D.

Calcutta University, Calcutta, India,
Department of Applied Chemistry.

Journal of the Institution of Engineers (India), Vol. 55, Part Ph 2, p 33-36, February, 1975. 2 tab, 19 ref.

An investigation was conducted to determine whether fly ash could be used alone or in combination with alum or alum sludge for the coagulation step in water treatment. River water samples were collected from the Ganges River (India) from a fixed depth of the basin throughout the representative seasons of the year. A sample of fly ash from a boiler plant was collected from the Palta Water Works. It was pretreated by washing with distilled water to remove free alkali and passing the dried mass through a 100 mesh sieve. Large, well formed flocs tended to settle well and removal of turbidity was satisfactory in the case of high turbidity water. The decrease in alum requirement with fly ash was small at lower levels of turbidity. Additions of sludge and fly ash were effective up to a certain concentration of ash. The order of the addition of the coagulant and the ash was a determining factor. Efficiency of coagulation was found to depend largely on the extent of dispersion. The joint influence of ash and sludge is more than an additive function. The recycling of fresh sludge and ash treatment in coagulation reduces the time of settling up to 33.33%, minimizes the problem of sludge disposal and decreases the cost of coagulant required. The most efficient bacterial kill was observed with a combination of sludge and ash. Fly ash also increases the removal of water fleas (Daphnia) by sedimentation and therefore reduces the load on the filtration units. The use of fly ash in combination with alum does impart some advantages from the point of view of efficiency of treatment and also results in cost savings because of reduced alum requirements.

*Water treatment, *Coagulation, Fly ash, Daphnia, Chemical precipitation, Water purification

Alum, Alum sludge

D354
FLUORIDATION ANALYSIS: THE BOSTON STORY,

Matera, J. J.

Boston Metropolitan District Commission,
Boston, Massachusetts.

American Water Works Association Journal, Vol. 67, No. 8, p 459-462, August, 1975. 3 fig, 1 tab.

The objective in fluoridation of a water system is to achieve a concentration of residual fluoride ion in the range from 0.9 to 1.1 mg/liter consistently throughout the entire distribution system. The Boston, Massachusetts, Metropolitan District water supply system made an analysis of its distribution system in order to determine alternatives for fluoride injection and monitoring locations. Two alternative locations for injection points were identified: alternative I, fluoridation of major distribution reservoir outlets; and, alternative II, fluoridation on the aqueducts from the water supply reservoirs. The advantages and disadvantages of each alternative location, based on consideration and evaluation of existing facilities at each site, are presented in detail. A schematic diagram is given of the aqueducts and storage reservoirs showing the alternative location of fluoridation points. Alternative II was chosen as the most feasible location. Alternative II requires one less chemical storage and feed building and monitoring station than alternative I. It also provides for better centralization of facilities for chemical delivery and system operation, control, and maintenance and provides the best opportunity for diffusion and mixing of the fluoride solution.

*Water treatment, *Fluoridation, Distribution systems, Mixing, Public health, Aqueducts, Reservoirs, Water quality control, Monitoring, Potable water

365

D355
ULTRA-HIGH RATE FILTRATION PROBLEMS,

Horvath, I.

Technical University, Budapest, Hungary.

American Water Works Association Journal, Vol. 67, No. 8, p 452-453, August, 1975. 3 fig, 1 tab, 3 ref, 1 append.

The Darcy formula for calculating filtration rate based on hydraulic gradient and the related Kozeny-Carman relationships are not applicable for conditions with a Reynold's number greater than four. Kozeny-Carman equations only apply to the rate range of practical filtration where the rate of filtration is less than 20-25 m/hr. New relationships between rate of filtration and hydraulic gradient have been determined for streamflow conditions within high-rate sand filters typical of water treatment plants. The relationship was derived on the basis of analogies between the hydraulic process in porous media and physical analogies based upon Fourier's Law, Maxwell's Law, and Ohm's Law and also on an analogy based on transfer streams. The equations represent a hyperbolic relationship between rate of filtration and hydraulic gradient, the controlling factors of which are v sub max, the theoretical maximum value of rate of filtration in meters per hour and I sub sz, a parameter to be determined experimentally, having the character of a hydraulic gradient. These two factors include the influence of all geometrical and physical factors, such as grain size, void ratio, viscosity, density, and temperature, which have a role in the given filtration process. If the hydraulic gradient is much smaller than I sub sz, then the relationships simplify to the Darcy formula. The validity of the derived relationships was verified by experimental proofs from the literature and from the author's experiments. More research is needed to determine a more detailed hydraulic interpretation of the parameters v sub max and I sub sz.

*Water treatment, *Filtration, *Hydraulic gradient, Darcys law, Mathematical models, Flow rate, Fluid mechanics, Hydraulic models

Kozeny-Carman relationships, High-rate filtration, Rate of filtration

D356
AEROBIC DIGESTION AND EVAPOTRANSPIRATION IN HOME DISPOSAL SYSTEMS,

Dea, S. J.

Water and Sewage Works, Reference Number, p R76-80, R82, April 30, 1975. 4 fig, 7 ref.

A unique waste water treatment and disposal system for an individual dwelling or home usage is described. The system can be used as an alternate to standard septic tanks which are unsuitable for many soil and geological conditions. The system design includes batch extended aeration, an elevated-mound disposal field and evapotranspiration using native or planted vegetation. The following engineering criteria were used to formulate the system design: the infiltrative surface should be no less permeable than any undisturbed parallel plant within the system; the soil surface should be managed so as to disperse clogging material; there should be no abrupt change in particle size between trench fill or surface cover material and soil at the infiltrative surface; continuous flooding of the infiltrative surface must be avoided; aerobic conditions should be maintained in the soil system; the entire infiltrative surface should be loaded uniformly and simultaneously; and, the amount of suspended solids and nutrients in the applied water should be minimized. Brief descriptions and basic justifications are presented for each of the three distinct component parts of the waste treatment and disposal system: biological treatment-batch extended aeration; effluent distribution and percolation; and, soil treatment and evapotranspiration. A cost analysis is given for a three-bedroom home in the Philadelphia, Pennsylvania, suburbs.

*Waste water treatment, *Waste water disposal, *Domestic wastes, Septic tanks, Design criteria, Evapotranspiration, Plant populations, Percolation, Biological treatment

D357
CHICAGO'S SWITCH TO FREE CHLORINE RESIDUALS,

Willey, B. F., Duke, C. M., and Rasho, J.

Water Purification Laboratory, City of Chicago,
Chicago, Illinois.

American Water Works Association Journal, Vol. 67, No. 8, p 438-441, August, 1975.
2 fig, 15 ref.

Chicago, Illinois, practiced superchlorination prior to coagulation, sedimentation, and filtration followed by postchlorination and ammoniation as water entered the distribution system until January, 1973, when the filtration plants converted to providing free chlorine residuals throughout the city. The results of the first year of operation are discussed. There were 70 more taste or odor complaints in 1973 than in 1972; only one person in 50,000 noticed the change enough to notify water quality surveillance personnel. Average chlorine residuals leaving the plant have been held close to 0.75 mg/liter of free chlorine and 0.12 mg/liter of combined chlorine. The city instituted an Employees Sampling Program whereby frequent sampling of home taps of scientific and technical personnel of the water department would be made to increase the division's already established sampling program. In 1973, an average of 741 samples per month were reported. Conferences held with the distribution division uncovered areas where valve readjustment could improve flow patterns. Controlled-flushing of fire hydrants, and a program of more frequent surveillance has improved areas of low flow or dead ends.

*Water treatment, *Chlorination, *Distribution systems, Water quality control, Samples

Chicago (Ill), Free chlorine residuals

D358
THE ROLE OF MIXING IN EQUALIZATION,

Bradley, P. R., and Oldshue, J. Y.

Mixing Equipment Company, Incorporated,
Rochester, New York.

Water and Sewage Works, Reference Number, p R173-R177, April 30, 1975. 5 fig, 3 tab.

Proper selection of equalization basin volumes and mixing equipment can reduce the investment and operating costs for physical, chemical, and biological treatment systems, and can produce a system that is less susceptible to upsets and that will consistently provide a better quality effluent than an unequalized system. The hydraulic equalization basin is characterized by a varying flow into the basin and a constant flow from the basin and will dampen out fluctuations in influent stream concentrations and flow. The second type of equalization basin contains a constant volume and will only dampen fluctuations in concentration. The most typical type of waste stream is one in which both flow and concentration vary. Equalization of these streams can be effected by either fixed or varying volumes in the equalization basin. Proper installation and baffling of the fluid agitation equipment used to provide mixing in the system is critical to the successful operation of an equalization system. Blending in waste treatment is a flow controlled operation which means that large diameter impellers running at slow speeds require less horsepower for the same degree of blending than do small high speed impellers. For a mixer to operate properly a well baffled system is required in order to make maximum use of the applied power. Correct baffling ensures a uniform fluid regime and provides for a constant and uniform power draw.

*Waste water treatment, *Equalizing reservoirs, *Mixing, Equipment, Flow control, Waste dilution, Circulation

*Equalization basins, Flow fluctuations, Concentration fluctuations

D359
PILOT-SCALE, HIGH-RATE BIOLOGICAL DENITRIFICATION,

Jeris, J. S., and Owens, R. W.

Ecolotrol, Incorporated,
Bethpage, New York.

Journal Water Pollution Control Federation, Vol. 47, No. 8, p 2043-2057, August, 1975. 14 fig, 5 tab, 4 ref.

A pilot scale fluidized bed reactor was installed at the Bay Park Water Renovation Plant, Nassau County, New York, to denitrify the waste water before disposal of the waste water into the groundwater table. The reactor consisted of five 0.6-cm thick Plexiglas sections 0.46-m in diameter. A 0.3-cm thick steel flow distribution plate was positioned 0.46-m up from the base of the column and covered with 3.8-cm of pea gravel and about one m or 270 kg of white silca sand with an effective size of 0.6-mm and a uniformity coefficient of 1.5. A schematic diagram of the nitrification and denitrification processes is presented. High-rate denitrification in a fluidized bed of sand covered with denitrifying biomass was successfully demonstrated at this moderate sized pilot plant treating 136,000 liters/day. The system consistently produced greater than 99% removal of the influent nitrogen in less than 6.5 minutes at a flux rate of 620 liters/min/sq m. The full potential of this system has not yet been determined. The average removal was 5,450 kg of NO3-N/day/cu m of reactor volume but the system was also able to remove up to 20,700 kg/day/cu m. Nitrogen removal efficiency was not affected by diurnal flow variation and a 17-hour shutdown. The operation routine was simple, trouble-free, and required little time. The removal ability was greater than the concentrations of nitrate-nitrogen that would be expected in a municipal treatment plant. The proven efficiency of this system as well as its low space requirements and ease of operation should make it a viable denitrification alternative method.

*Waste water treatment, *Denitrification, Nitrification, Municipal wastes, Nitrogen, Recharge, Groundwater, Water pollution control, Pilot plants

Fluidized bed reactor, Nassau County (NY)

D360
ACTIVATED CARBON: OLD SOLUTION TO OLD PROBLEM, PART I,

Adams, A. D.

ICI United States Incorporated,
Wilmington, Delaware,
Specialty Chemicals Division.

Water and Sewage Works, Vol. 122, No. 8, p 46-48, August, 1975. 2 fig.

Laboratory and full scale field trials, conducted from 1972-1974, have shown that the addition of powdered lignite activated carbon to anaerobic digesters will minimize operating problems and lower sludge disposal costs. In the laboratory test, municipal sludge was digested in a batch treatment process and gas evolution was measured. After three weeks, methane production in the digester dosed with lignite carbon was five times that of the control. The first field evaluation was performed at a two mgd trickling filter plant using two stage digestion. Powered activated carbon was added to the primary sludge and supernatant clarity and gas production were monitored. After two weeks, the supernatant clarity had improved measurably, the vacuum filter operation had improved, and the necessity for the use of FeCl3 and lime had decreased. However, the expected increase in gas production did not occur, possibly due to the presence of industrial wastes. Activated carbon was then added to the sludge in a two stage digestion system of a 1.8 mgd trickling filter plant. Clarity of the supernatant improved and gas production increased from an average of 7500 cu ft/day to 11,000 cu ft/day. The third evaluation was performed at a two mgd activated sludge plant with a severely overloaded two stage digestion system. The supernatant was improved, gas production increased, and use of vacuum filtration was no longer necessary as a result of the addition of activated carbon.

*Waste water treatment, *Activated carbon, Lignite, Sludge treatment, Methane, Sludge digestion, Filtration, Trickling filters, Anaerobic digestion

Powdered activated carbon

D361
WATER TREATMENT PLANTS DESIGNED AT MELYEPTERV FOR FOREIGN CUSTOMERS (MELYEPTERV ALTAL KULFOLDRE TERVEZETT VIZKEZELO BERENDEZESEK),

Satorhelyi, T.

Hidrologiai Kozlony, Vol. 55, No. 6, p 263-265, June, 1975. 3 fig.

Since 1968, the Hungarian company, Melyepterv, has prepared designs for water treatment plants in Lebanon, Yugoslavia, Czechoslovakia, and the German Democratic Republic, as well as in Hungary. The water treatment plants designed at Melyepterv are constructed under the supervision of the designer, who also participates in the testing and pilot operation of the plants. The facilities are designed according to the most advanced technologies and high aesthetical standards are reached by observing the latest principles in power supply and automatic controls.

*Water treatment, *Treatment facilities, *Design, Foreign research, Automation, Control systems, Power operation and maintenance

D362
TREATMENT OF SURFACE WATERS FOR DOMESTIC SUPPLY (FELSZINI VIZEK KEZELESE IVOVIZ CELJARA),

Palhydy, A.

Hidrologiai Kozlony, Vol. 55, No. 6, p 245-250, June, 1975. 3 fig, 1 tab, 5 photos.

The use of surface waters rather than groundwater resources as a source of drinking water became prevalent in Hungary about 20 years ago. In order to obtain the same quality of drinking water as from groundwater, advanced treatment of surface waters must be performed. The professionals engaged in water treatment design at the Melyepterv have developed the designs for ten major surface waters treatment plants, with capacities ranging from 5 to 200 thousand cu m/day. The raw water for domestic supply use is diverted from the Danube and the Tisza rivers. The treatment plants include advanced drum filters, complex chemical feeding devices, clarifiers and filters. Suspended and dissolved solids are removed by oxidation, adsorption, chemical coagulation, and filtration. The newest plants are also designed using ozone treatment and activated carbon filtration. Melyepterv has developed floating silt blanket clarifiers which are provided with multiple controls to manage difficult treatment problems. The large open filters employed are designed with corrosion resistant and economical filter bottoms and are equipped with electric controls. A high standard of operation at the treatment plants is facilitated by advanced instrumentation and laboratory equipment, by extensive remote controls, and by mechanical equipment which eliminates much of the physical labor.

*Water treatment, *Treatment facilities, *Potable water, Surface waters, Water resources, Oxidation, Adsorption, Filters, Coagulation, Activated carbon, Ozone, Control systems, Instrumentation, Equipment, Foreign research

Melyepterv, Hungary

D363
UPGRADING LAGOON EFFLUENT FOR BEST PRACTICABLE TREATMENT,

Stone, R. W., Parker, D. S., and Cotteral, J. A.

Brown and Caldwell,
Walnut Creek, California.

Journal Water Pollution Control Federation, Vol. 47, No. 8, p 2019-2042, August, 1975.
16 fig, 9 tab, 11 ref.

Modeling efforts and studies performed by the University of California's Sanitary Engineering Research Laboratory, Berkeley, state and federal agencies, and engineering consultants have determined that the water pollution problems associated with the South Bay segment of the San Francisco Bay system may be mitigated by appropriate control measures such as upgrading existing treatment facilities to a level of quality higher than that defined by federal secondary treatment standards. The potentially feasible alternatives for upgrading the Sunnyvale, California, treatment plant were identified. The apparent best alternative project was determined to be to add fixed growth reactors for nitrification and dissolved air flotation and gravity filtration for algae removal and dechlorination. Pilot plant studies of the tertiary treatment processes identified in the apparent best alternative project were started in spring 1973. Studies were performed on dissolved air flotation, filtration, breakpoint chlorination, and nitrification using fixed growth reactors. Maximum allowable loading rates, chemical requirements, and operational parameters were evaluated for each of the unit processes. A schematic drawing of existing and proposed facilities is presented.

*Waste water treatment, *Sewage treatment, *Treatment facilities, Water quality, Flotation, Filtration, Nitrification, Chlorination, Algae

Dissolved air flotation, Gravity filtration, Breakpoint chlorination, Fixed bed reactors

D364
MEMBRANE PROCESSES FOR WATER TREATMENT, CONCLUSION,

Craig, J. B., Gardner, C. R., and Meares, P.

Aberdeen University, Aberdeen,
Scotland, Department of Chemistry.

Effluent and Water Treatment Journal, Vol. 15, No. 7, p 345, 353-356, July, 1975.
2 fig, 45 ref.

The four basic designs of reverse osmosis modules are the plate-and-frame, tubular, spiral-wound, and hollow-fiber types. The main applications of reverse osmosis (RO) are in the field of desalination and in the treatment of waste and rinse waters. RO will remove non-ionic and organic as well as ionic pollutants. RO is also used as a concentrating and fractionating technique in the food and pharmaceutical industries. It is an attractive alternative to other separation and concentration processes because of its simplicity, versatility, broad applicability, and low energy requirements. The costs per unit produced generally decrease as the size of the plant increases. Overall operating costs are largely affected by the cost and frequency of membrane replacement. A recently introduced membrane process is piezodialysis. Differences between this process and RO are that this process uses charge-mosaic membranes and that the permeate under pressure is a liquid stream far more concentrated than the feed which becomes less concentrated and forms the product in a desalination process. A charge-mosaic membrane contains a parallel alternating array of cation and anion-exchanging resins each of which extends throughout the active thickness of the membrane. Piezodialysis offers the following advantages: small defects in the membrane may cause only a slight decrease in the efficiency of the process and not serious contamination of the product water as would occur in reverse osmosis; uncharged contaminants are likely to remain in the product water from piezodialysis; and, the concentration of salt in the product water can be varied by changing the length of the desalination chamber.

*Water treatment, *Desalination, *Membrane processes, *Reverse osmosis, Desalination processes, Separation techniques, Membranes, Semipermeable membranes

D365
CURRENT TRENDS IN PACKAGED WASTEWATER TREATMENT FACILITIES, PART I,

Dresnack, R., and Miller, W.

Water and Sewage Works, Vol. 122, No. 8, p 60-63, August, 1975. 5 fig.

A state-of-the-art report is presented on package waste water treatment plants. The advantages, disadvantages, process variations and cost variables of package plants are discussed. Performance data and a selection guide are also included. Package plants can be classified as using either biological or chemical treatment methods. There are significant differences among package plants using biological processes. The basic difference between the systems is the manner in which the required hardware is assembled. The digestion of organic wastes by microorganisms in the contact stabilization process is a two step process. In step one, the microorganisms consume the organic wastes. Metabolic digestion or biochemical breakdown of the material consumed occurs in step two. Two configurations of package contact stabilization units that are commercially available are a circular plant and a rectangular plant with a mechanical sludge handler. Completely mixed activated sludge systems operate as homogeneous systems where the organic waste is well mixed with the seed sludge during aeration. Many variations in size, shape and operational features can be found among completely mixed systems.

*Waste water treatment, *Treatment facilities, *Biological treatment, Organic wastes, Microorganisms, Activated sludge

Contact stabilization systems, Completely mixed systems, Package plants

D366
WASTEWATER SOLIDS SEPARATION,

Cheremisinoff, P. N., and Feller, S. M.

Pollution Engineering, Vol. 7, No. 8, p 26-33, August, 1975. 9 fig.

Equipment for the removal of suspended solids from water and waste water is detailed. New methods meet high-level treatment requirements for nonbiodegradable wastes, independent of living organisms. The new systems described maintain predictable control and absorb shock loads with minimal effects on effluent quality. Screening equipment includes rotary screens to remove coarse solids from waste water; static screens employ a large screen surface at a steep angle so that dewatered solids travel down the surface of the screen into a sump; vibrating screens trap solids which are moved to the periphery of the screen element for disposal; microstrainers use a drum mechanism covered with a special weave fabric to separate small suspended particles. The many types of existing filters, the surface-contact type, or slow sand filters, sit on a system of collection and drainage pipelines; rapid sand filters are also surface filtration devices which are composed of a layer of graded sand supported on layers of graded gravel, some with coagulants added in a rapid mixing basin; moving bed filters are a continuous rapid sand type filter with a counter-current sand and influent flow direction; in-depth filters are an improvement on the rapid sand filter, with a gradation of grain size from coarse to fine in the direction of the flow. Other separation techniques are diatomaceous earth filtration, a type of mechanical separation, and grass plots used as a system when effluents are irrigated over grasslands. Lagoons and oxidation ponds, settlers, thickeners, and clarifiers, are also described and illustrated.

*Separation techniques, Filters, Filtration, Waste water treatment, Diatomaceous earth, Screens, Sands, Equipment, Water treatment, Clarification, Settling basins, Particle size, Lagoons

*Suspended solids removal, Rotary screens, Rapid sand filters, In-depth filters

D367
SLUDGE ACTIVITY AND FULL-SCALE PLANT CONTROL,

Coackley, P., and O'Neill, J.

Strathelyde University,
Yorkshire, Great Britain,
Department of Civil Engineering.

Water Pollution Control, Vol. 74, No. 4, p 404-414, 1975. 8 fig, 2 tab, 15 ref. 1 append.

Three recognized processes in activated sludge treatment are adsorption, flocculation, and biological oxidation. Discussion was given to the mechanism of the initial rapid removal of BOD, with emphasis on microbiological activity. Full-scale activated sludge plant studies indicated a significant increase in the level of dehydrogenase activity, as seen by the production of formazan, as the organic load to the sludge increased. A threefold increase in formazan yield was found to occur within 30 minutes of the addition. Toxic materials in the plant had a major role in the reduction of dehydrogenase activity. These may be measured by a dye such as triphenyl tetrazolium chloride (TTC), which gives early warning of toxic substances not normally monitored. From both full-scale plant and laboratory tests sludge activity measurements (expressed as yield of formazan from TTC/unit weight MLVSS) were shown to have potential for use in activated sludge plant control. Using graphs and tables compiled from plant data for formazan yield under a variety of conditions, a facility operator could assess: the ability of an activated sludge to metabolize a particular industrial effluent; whether sludge was underloaded or overloaded; and whether the sludge was affected by a toxic material. It is suggested that many sewage works are equipped to implement this control system, and that the method could be developed for automatic analysis.

*Activated sludge, *Treatment facilities, *Control systems, Toxicity, Waste water treatment, Automation, Monitoring, Biological treatment, Biochemical oxygen demand, Analytical techniques

Dehydrogenase activity, Sludge activity measurement, Triphenyl tetrazolium chloride (TTC)

D368
TREATMENT TRIO TAMES ORGANICS, KILLS BACTERIA,

Chemical Engineering, Vol. 82, No. 17, p 63, August 18, 1975. 1 fig.

An alternative to chlorine disinfection of waste water has been tested, using a combination of gamma rays, ozone, and activated carbon. Compressed air is utilized to agitate waste water in an oxygenation chamber; ozone is then injected in the waste water from the bottom of the chamber. This raises the dissolved oxygen level to about 25 mg/liter, which is necessary to oxidize the organics completely to carbon dioxide and water. Waste water is then pumped from the oxygenation tank to an irradiator/activated carbon hybrid which is filled with activated carbon and has cobalt-60 rods in the center of a column. When organics attach to the column and are irradiated, the dissolved oxygen content drops to two to three mg/liter and color is reduced by 90 to 99%. Ozone is then injected into the discharge line, raising the dissolved oxygen level to about 14 mg/liter. While gamma rays alone kill 99% of viruses and bacteria and ozonization alone kills 95-96%, the synergistic effects of the combination remove practically 100%. A pilot plant has been operated at a 5000 gallons/day poultry processing facility in Marietta, Georgia. Even with influents containing 1150 mg/liter organics the organics loading has been reduced by 95%. Because the radiation dose concentrates on the organics rather than the whole waste water stream, operating efficiency is higher and costs are lower.

*Waste water treatment, *Ozone, *Activated carbon, Pilot plants, Gamma rays, Treatment facilities, Disinfection, Oxygenation, Organic matter, Operating costs

Cobalt-60

D369
HOW TO DESIGN ACTIVATED SLUDGE UNITS,

Thomson, S. J.

Fluor Engineers and Constructors, Incorporated,
Los Angeles, California, Environmental Engineering Department.

Hydrocarbon Processing, Vol. 54, No. 8, p 99-102, August, 1975. 5 fig, 6 ref.

Activated sludge units for treatment of biodegradable substances need to be designed with considerable flexibility because the values of some operation parameters cannot be exactly determined. The consumption of biodegradable materials in aerated activated sludge systems varies with temperature, population of microorganisms, nutrient availability, oxygen supply, and type and concentration of organics in the feed. The design procedure described was developed using pilot and industrial operating data for activated sludge plants in the refining and petrochemical industry but similar design relationships can be determined for the design of units for other industries by similar collection and evaluation of appropriate data. Graphs are presented which show the following operating data: residence time; sludge production; sludge age; and oxygen requirement. Interpretation of the graphs is demonstrated by a sample problem. The steps in the procedure are to: establish the required food to microorganism ratio; determine the required aeration basin volume for a MLVSS concentration of 2,500 mg/liter; calculate the aeration residence time; establish sludge production; check sludge age; establish oxygen requirement; determine design return activated sludge flow; calculate nutrient requirements; and, determine the temperature correction.

*Waste water treatment, *Activated sludge, *Treatment facilities, *Design criteria, Industrial wastes, Biodegradation, Sludge, Microorganisms, Temperature, Organic compounds, Nutrients

Refineries, Petrochemical industry

D370
SEWAGE AND EFFLUENT-CHEMICAL ENGINEERING DEVELOPMENTS ON THE WAY,

Butler, P.

Process Engineering, p 85-87, June, 1975. 5 fig, 1 tab.

New chemical engineering processes for effluent treatment are discussed. The ICI deep shaft aeration process for treating both sewage and industrial effluents is an air-lift type of fermenter, in which the air for biological oxidation also provides the driving force for liquid circulation. A pilot plant is now in operation at the Billingham sewage works, United Kingdom. Satec, U.K., (an Air Products Subsidiary) has been working on a pilot plant program for oxygen-activated sludge treatment. Research has been conducted on both mixed and staged variants of oxygen-activated sludge systems. The Rotapur process consists of physico-chemical treatment followed by catalytic oxidation. This process has been applied to sewage treatment, textile effluent treatment, pig slurry, industrial waste waters containing phenol, and gas cleaning/odor control. The Alwatech process is a purely physico-chemical method of treating food industry wastes combined with protein and fat recovery. The Alwatech process combines precipitation of the protein and/or fat with dissolved air flotation to bring the solids to the surface of the liquor where they can be skimmed off. The Alwafloc process for fat recovery treats waste water with trivalent metallic ions under acid conditions, followed by the addition of calcium ions to raise the pH and an anionic polyelectrolyte to strengthen the floc. The Alwatech process has been used in treating wastes from slaughter houses and poultry processing plants. The Alwafloc process has been used for effluents from poultry plants, margarine and edible oil plants, and in the petrochemical industry.

*Waste water treatment, *Chemical engineering, Sewage treatment, Industrial wastes, Equipment, Activated sludge, Oxygen

Physico-chemical treatment, ICI deep shaft process, Oxygen-activated sludge, Alwatech process, Alwafloc process, Catalytic oxidation

D371
POLIOVIRUS INACTIVATION BY ACTIVATED SLUDGE,

Malina, J. F., Jr., Ranganathan, K. K., Sagik, B. P., and
Moore, B. E.

Texas University, Austin,
Civil Engineering Department,
Environmental Health Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 8, p 2178-2183, August, 1975.
6 fig, 2 tab, 10 ref.

An evaluation of the permanent inactivation of virus in the activated sludge process was performed. Activated sludge was inoculated with tritium-labeled poliovirus in batch reactors, and the fate of the virus was followed by tracing the radioactive label and infectivity with time. The initial total virus in the system was 4.8 times ten to the tenth power PFU. The initial adsorption of 1.9 times ten to the ninth power PFU/g of sludge was followed by a period of no significant reduction in the titer in the supernatant. The decrease in infectivity titer of the supernatant after a period of one hour followed the empirical relationship: the initial virus concentration in the supernatant per gram of initial MLSS (PFU/ml-g) equals the virus concentration in the supernatant at any time t (PFU/ml-g) times the time in minutes raised to a constant of 0.32. The results indicate that some of the poliovirus adsorbed to the activated sludge particles is inactivated and that virus particles that are not infective may be released into the supernatant. However, the association of virus particles with sludge and the fact that infectious virus particles can be eluted from sludge solids must be considered in evaluating sludge disposal alternatives and in virus monitoring techniques proposed for sewage treatment plant effluents.

*Waste water treatment, *Activated sludge, *Viruses, Disinfection, Sludge disposal, Monitoring, Viricides, Sewage treatment, Public health, Diseases, Epidemiology, Microbiology

*Poliovirus

D372
INTERMITTENT SAND FILTERS FOR UPGRADING LAGOON EFFLUENTS,

Reynolds, J. H., Harris, S. E., Hill, D., Filip, D. S., and
Middlebrooks, E. J.

Utah State University, Logan,
College of Engineering, Utah Water Research Laboratory.

Public Works, Vol. 106, No. 9, p 91-94, September, 1975. 1 fig, 2 tab, 5 ref.

An experimental full-scale plant was built at the lagoon treatment plant of the City of Logan, Ohio, to test the effectiveness of intermittent sand filters for polishing lagoon effluents. The facility consisted of six filters, each 25 by 36 feet and containing three feet of pit-run concrete sand with an effective size of 0.17 mm and uniformity coefficient of 9.7. Data were collected and analyzed for hydraulic loading rates ranging from 0.2 mgad to 1.2 mgad. The alga genera present in the lagoon effluent had little effect on the performance of the intermittent sand filters. The length of the filter run was directly related to the influent algal concentration and hydraulic loading rate. The effluent total suspended solids concentration increased slightly with an increase in the hydraulic loading rate. When the average influent volatile suspended solids (VSS) concentration was 16.9 mg/liter, the filters produced an effluent with less than 1.5 mg/liter of VSS. The intermittent sand filter produced a consistent effluent BOD of less than 5 mg/liter and filtered effluent BOD and COD increase slightly with an increase in the hydraulic loading rate. The influent ammonia-nitrogen concentration were reduced from 2.5 mg/liter to less than 0.54 mg/liter. The pH values of filter effluent were approximately 8.0 but ranged between 7.9 and 8.9. The full-scale filter tests essentially duplicated the performance of laboratory and pilot scale tests.

*Waste water treatment, *Lagoons, *Filters, Water quality, Suspended solids, Biochemical oxygen demand, Chemical oxygen demand, Sands

*Intermittent sand filters, Hydraulic loading rate

D373
AMMONIA REMOVAL-WHAT'S BEST?,

Mioduszewski, D.

Wastewater Applications Research,
Calgon Corporation, Pittsburgh, Pennsylvania.

Water and Wastes Engineering, Vol. 12, No. 7, p 34, 36, 38, 40, 45-46, July, 1975.
4 fig, 2 tab.

The relative advantages and disadvantages of the different processes for ammonia removal are compared on an equivalent technical and economic basis. Ammonia removal by ion exchange involves the displacement by ammonium ions of some other cation from an insoluble exchange medium. Natural zeolite, such as clinoptilolite, has shown the best selectivity for ammonia. The success of the clinoptilolite process is greatly dependent on the development and demonstration of an economical, practical, and environmentally sound method of recycling the regenerant. Two methods of treating the regenerant are ammonia stripping to the atmosphere or to recovery systems and breakpoint chlorination. Nitrogen removal can be achieved biologically through the processes of nitrification and denitrification. In the nitrification process, ammonia is oxidized aerobically to nitrite and then to nitrate. The denitrification step removes the nitrogenous oxygen demand; nitrate is anaerobically converted to nitrogen gas. The three major types of process configurations for nitrification-denitrification are combined sludge, separate sludge, and submerged filter systems. The air stripping process for ammonia removal involves raising the pH of the waste water to 10.5 to 11.5 and providing sufficient air-water turbulent contact and air flow to strip the ammonia gas from solution. Chlorination of waste water results in an increase in chloramine species up to a maximum after which the concentration of chloramines falls to a minimum which is termed the breakpoint. Addition of activated carbon to the process as a catalyst/dechlorinator seems to concentrate the oxidizing power of the applied chlorine. Air stripping is the least expensive treatment method, ion exchange with regenerant recovery is the most expensive.

*Waste water treatment, *Ammonia, Ion exchange, Denitrification, Nitrification, Chlorination, Activated carbon, Nitrogen

Air stripping, Breakpoint chlorination, Chloramines

D374
SEWAGE TREATMENT AND DISCHARGE INTO TROPICAL COASTAL WATERS,

Nedwell, D. B.

University of the South Pacific,
Suva, Fiji,
School of Natural Resources.

Search, Vol. 5, No. 5, p 187-190, May, 1974. 2 fig, 25 ref.

Sewage discharged into coastal seawater in tropical areas is most often discharged into barrier-reef lagoons rather than into the open sea. Because very little mixing takes place and because tropical seawater is naturally nutrient-deficient, the eutrophication that occurs seriously disrupts the ecological balance. While several alternatives have been implemented--primary and secondary treatment of raw sewage, further treatment to remove soluble inorganic phosphorus and nitrogen, package treatment for sewage from recreational "tourist" areas--a new suggestion has been proposed. This is the concept of discharging treated sewage effluents, particularly the nitrogenous portion, into a mangrove-bounded estuary. A mangrove environment is naturally rich in organic material so that increased organics are not as disruptive as in the organically poor lagoon and reef. The mangrove area, which is common to many tropical regions, may act as a tertiary treatment site and discharge point. Simple retaining ponds in mangrove areas may then result in an effluent with large fractions of inorganic nutrients removed. Costs of building outfall pipes to sea may also be eliminated.

*Eutrophication, *Effluents, Sewage disposal, Algae, Sewage treatment, Waste water treatment, Tertiary treatment

*Tropical coastal waters, *Mangroves

D375
GIANT 1 472 Ml/d WATERWORKS AT GARDEN REACH, CALCUTTA,

Mukherjee, R. N.

Calcutta Metropolitan Planning Organization,
India.

Journal of the Institution of Engineers (India), Vol. 55, Part PH2, p 43-45, February, 1975.

The Calcutta Metropolitan Planning Organization, India, found that existing water treatment facilities at Palta provide an inadequate water supply. A new facility, the Garden Reach Water Treatment Plant was proposed to serve the southern part of the Metropolis. The river Hooghly will be the source of water supply, with the planned construction of a dam (the Farrakka Barrage) to increase water quality and quantity. Treatment will consist of: presettlement of raw water for six hours in a raw water lake; prechlorination of the silted water to control bacteriological and algal growth; coagulation; flocculation and settlement of suspended solids; filtration through rapid sand filters; and post-chlorination. An underground filtered water reservoir of 82,000 cu m will receive filtered water. When completed, the facility will be the largest in Asia and will produce 1,472 Ml/d filtered water for Calcutta.

*Water treatment, *Water supply, Treatment facilities, Coagulation, Flocculation, Filters, Potable water

Calcutta (India)

D376
CONTROL OF SURFACTANT POLLUTION,

Gupta, S. K., Biswas, R. D., and Ghosh, K.

Indian Journal of Environmental Health, Vol. 17, No. 1, p 21-25, January 1975.
2 fig, 1 tab, 5 ref.

A method was investigated for the removal of surfactant pollution from river water by the application of prime coagulant alum together with either fly ash or alum sludge. Both alum sludge and fly ash from water treatment stations had been considered useless by-products which caused their own disposal problems. Experiments were performed on water samples from the Ganga River collected at the Palta Water Works, Barrackpore, India. These samples contained the anionic surfactants sodium dodecyl benzene sulfonate (NaDBS) and sodium dodecyl sulfate (NaDS) and the cationic surfactants cetyl trimethyl ammonium bromide (CTAB) and cetyl pyridirium chloride (CPYCl). The solutions of river water containing these surfactants were treated with variable doses of alum together with fly ash or alum sludge. The remaining surfactant concentrations were evaluated by the surface tension measurements at 30 C, representing the amount of surfactant absorbed. As was shown graphically, both fly ash and alum sludge, when applied together with the prime coagulant alum, were able to minimize the surfactant concentration in the river water samples.

*Surfactants, *Water treatment, *Rivers, Coagulation, Recycling, Waste disposal, Foreign research, Water pollution control

Alum sludge, Fly ash, Chemical treatment, India

D377
WHY CHLORINATE?,

Duffield, G.

Water and Pollution Control, Vol. 113, No. 8, p 27-28, August, 1975.

The use of chlorination is defended as a necessary method of water treatment in Canada. While other possible methods of disinfection--ozone, chlorine dioxide, or ultraviolet light--may be implemented, chlorine is the only one to leave a residual. Chlorine in a small fraction of a ppm amount will not protect a given system against massive infiltration, a cross connection, or a main break. However, the purpose of such a chlorine residual is to serve as an indicator that the system is in good condition. If a system is regularly monitored for the residual and it is found that the residual has at some point disappeared, then the cause of the irregularity should be investigated. The need for chlorination disinfection in a watershed is supported by the multiple uses of a natural body of water, whereby bacteria may enter into the system from an animal population or from the disposal of sewage. Groundwater sources should be chlorinated to protect against iron- or sulfate-reducing forms of bacteria which might cause undesirable tastes or odors, colored water, slime growths, or equipment corrosion. While a recent EPA report found 66 compounds in the New Orleans' water supply which are combinations of chlorine and organic chemicals, and may be carcinogenic, this argument is countered by the fact that there is not enough evidence that the drinking of chlorinated water causes cancer. Chlorine is argued to still be the best disinfectant available for water treatment and bacterial control.

*Chlorination, *Disinfection, *Water treatment, *Groundwater, *Surface waters, Chlorine, Water pollution control, Monitoring, Canada, Watershed management

D378
ACIDIFIED ALUM SLUDGE AND FLY-ASH AS ADJUNCT TO COAGULATION,

Adhikari, M., Gupta, S. K., and Biswas, R. D.

Calcutta University, India,
Department of Applied Chemistry.

Journal of the Indian Chemical Society, Vol. 52, No. 2, p 127-130, February, 1975.
4 tab, 33 ref.

The possibility of using acidified alum-sludge and acidified fly-ash as adjuncts to coagulation in the treatment of river water for municipal supply and their capability to reduce coliform bacterial count and algae populations in the usual alum coagulation process was investigated. A comparison of actual alum requirements and those when it is used together with sulfated or phosphated sludge and with sulfated or phosphated ash was made. Sulfated sludge and phosphated ash reduced the settling time and floc formation by 33% and 50%, respectively. The application of these adjuncts was found to minimize the disposal problem and to reduce the capital costs of chemical treatment. Sulfuric acid treated sludge was the most effective adjunct for water in the higher turbidity range. Coliform counts were also successfully diminished in supply water and the flocculation of both phytoplanktons and zooplanktons usually present in river water was initiated.

*Water treatment, *Municipal water, *Flocculation, Bacteria, Coagulation, Sludge, Rivers, Potable water, Coliforms

Sulfated sludge, Phosphated ash, India, Alum

D379
SHALLOW DEPTH SEDIMENTATION-A RATIONAL APPROACH TO WATER AND WASTEWATER CLARIFICATION,

Paramasivam, R., and Kelkar, P. S.

National Environmental Engineering Research Institute,
Nagpur, India.

Journal of the Institution of Engineers (India), Vol. 55, Part PH 2, p 46-50, February, 1975. 6 fig, 2 tab, 21 ref.

The development of the shallow depth sedimentation principle is discussed. Diameter, specific gravity, shape and concentration of particles as well as temperature and tank hydraulics influence the settling characteristics of particles. The efficiency of sedimentation is dependent mainly on the surface loading or the tank overflow rate rather than on depth or detention time. One of the first (1915 patent) shallow depth sedimentation designs involved several shallow settling compartments formed by a series of conical circular trays placed one above the other. In the 1960s, the successful application of shallow depth sedimentation using small diameter (2.5-10.0 cm) tubes as settling devices was demonstrated. The two basic tube configurations are essentially horizontal and steeply inclined. Tube configurations meet the requirements of shallow depth, laminar flow conditions and reasonable overflow rates. The performance of the settlers depends largely upon the tube design. The tube height should be as short as possible to minimize the settling distance. Tube shape should permit nesting to eliminate waste space between tubes in a unit. Three proprietary tube settler units are described. Tube settlers are being employed at water treatment plants to reduce detention time or to increase capacity. Settling tubes used for the clarification of raw and trickling filter effluents were found to increase the capacity of existing clarifiers or improve the performance of poorly operating units.

*Waste water treatment, *Water treatment, *Sedimentation, Settling basins, Hydraulics, Suspended solids

*Tube settlers, *Clarification

D380
SEWAGE TREATMENT TO MEET TOMORROW'S NEEDS,

Truesdale, G. A., and Taylor, M. R. G.

Water and Pollution Control, Vol. 74, No. 4, p 455-565, 1975. 1 fig, 2 tab, 34 ref.

To meet the probable increase in water demand in the UK, it will be necessary to increase abstraction from rivers, resulting in an increase in the volume of sewage effluent requiring disposal and a reduction in the volumes of water in the rivers for dilution of this increased volume of effluent. Therefore, more stringent standards for sewage effluents will be required to protect potable water supplies. Processes that can be used to achieve higher effluent standards are discussed. The processes assume that sewage treatment will still be based on conventional biological methods with a combination of biological and physico-chemical methods where appropriate. The costs are based on 1971 conditions. Tertiary treatment processes discussed include: irrigation over grasslands; slow sand filtration; retention in lagoons; rapid sand filtration; microstraining; gravel bed clarifiers; and, nitrification, denitrification, and phosphate removal methods. Water reclamation processes include: activated carbon adsorption; ion exchange; electrodialysis; reverse osmosis; and thermal processes such as multistage and multiple effect evaporation. The capital expenditure on sewage treatment in the UK has risen from 20 million pounds in 1950 to 160 million pounds in 1973. It currently amounts to more than 0.5% of the gross national product of the UK.

*Waste water treatment, *Sewage treatment, Treatment facilities, Sewage works, Biological treatment, Costs, Water reuse, Water demand, Potable water, Irrigation, Filtration, Lagoons, Nitrification, Denitrification, Activated carbon, Membrane process

Physico-chemical treatment

D381
AERATION PLANT DESIGN: DERIVATION OF BASIC DATA AND COMPARATIVE PERFORMANCE STUDIES,

Badger, R. B., Robinson, D. D., and Kiff, R. J.

Water Pollution Control, Vol. 74, No. 4, p 415-429, 1975. 2 fig, 17 tab, 3 ref.

A single-stage activated sludge plant employing vertically-mounted mechanical aerators was chosen as the most economical method of expanding the waste water treatment facility at Rodbourne, U.K. An experimental program was conducted to establish comparative operating data for four configurations of activated-sludge processes. The configurations were: single pocket completely mixed; two pocket series flow; four pocket series flow; and, interseries flow which comprises two pockets completely mixed followed by two pockets series flow. Bench-scale tests were performed on all configurations. The interseries system proved to be the most ideal layout for effective bio-flocculation. The Rodbourne sewage was easily treated by activated sludge; a low residual COD concentration and full nitrification were effected. A pilot-scale test was conducted using the interseries flow configuration. This experimental program identified the most stable mode of operation and provided a large amount of information on the variables involved. An assessment of the mean values and standard deviation for independent process variables was made to ensure that the plant will be able to comply with effluent standards 90 percent of the time.

*Waste water treatment, *Sewage treatment, Treatment facilities, Activated sludge, Design criteria, Laboratory tests, Pilot plants

D382
'CATTY' ODOURS IN SEWAGE WORKS,

Stedman, J. V., and Matthews, P. J.

Water Pollution Control, Vol. 74, No. 4, p 471-473, 1975. 8 ref.

"Catty" odors have been reported at industrial slag heaps and sewage treatment plants, in an industrial effluent, and in food storage. The "catty" odor has been shown to be due to 4-methyl-4-mercapto-pentan-2-one, which results from a reaction between mesityl oxide and hydrogen sulfide. An investigation was conducted to determine the mechanism by which 4-methyl-4-mercapto-pentan-2-one could give rise to "catty" odors at sewage works. The following conclusions were reached. Mesityl oxide reacts with hydrogen sulfide in crude sewage sludge to produce 4-methyl-4-mercapto-pentan-2-one which has a strong "catty" odor. The sludge must be relatively fresh with a pH close to 6, and must have available sulfide present. If the pH of the sludge is higher than 6, then in the presence of sulfide, the threshold level of mesityl oxide for odor development may be as low as 0.01 mg/liter. If the "catty" odor results from the caustic demethanolation of pentoxone, then the problem may be solved by replacing this solvent with methyl isobutyl carbinol. This implies that the presence of compounds, such as pentoxone, which may be precursors to mesityl oxide must be prevented to avoid the "catty" odor in industrial waste water, sewage, and sewage sludge.

*Waste water treatment, *Odor, *Sewage treatment, *Industrial wastes, Hydrogen sulfide, Sewage works

*"Catty" odors, 4-Methyl-4-mercapto-pentan-2-one

D383
THE PERFORMANCE OF FULL-SCALE SLUDGE FLOTATION PLANT,

Burfitt, M. L.

Water Pollution Control, Vol. 74, No. 4, p 474-475, 1975. 1 tab, 2 ref.

Operating data from the largest sludge flotation plant currently installed on a sewage works in the United Kingdom is presented. The sewage treatment plant at Aycliffe, UK, was expanded in 1972 for a dry-weather flow of 24,000 cu m/day and a population equivalent of 132,000 persons. Surplus activated sludge is consolidated in two 23 sq m flotation units prior to mixing, further consolidated with primary sludge, and subsequently digested and filter pressed. Using the flotation technique, a surplus activated sludge containing 5000 mg/liter suspended solids can be thickened to yield a sludge which contains 4.0% dry solids. The flotation technique is very efficient; it can remove 99.6% of the influent suspended solids. Due to the current excess capacity in the plant, the sludge loading rate has been slightly reduced to produce a thicker sludge float one-ninth of its original volume.

*Sludge treatment, *Flotation, Waste water treatment, *Sewage treatment, Treatment facilities, Suspended solids, Activated sludge

D384
OBSERVATIONS ON THE PERFORMANCE OF POLISHING LAGOONS AT A LARGE REGIONAL WORKS,

Toms, I. P., Owens, M., Hall, J. A., and Mindenhall, M. J.

Water Pollution Control, Vol. 74, No. 4, p 383-401, 1975. 14 fig, 9 tab, 28 ref.

The use of lagooning as a polishing process was considered, in terms of number of lagoons, their retention periods, and depths required. Generally, except for the removal of phosphate and ammonia, it was found that several lagoons in series are better than a single lagoon of the same total retention period. The lagoons at Rye Meads Sewage Purification Works, Great Britain, were used for this study with the following conclusions. While lagooning of sewage effluent can be an efficient process for reducing suspended solids, BOD, fecal bacteria, nitrate, and phosphate, many of the required performance characteristics are not compatible. Thus, for the removal of the maximum amounts of ss, BOD, and fecal bacteria, lagoons should be operated in series. Because the growth of phytoplankton increases ss and BOD and reduces the mortality of fecal bacteria, it should be minimized by using a total retention period of up to four days in small consecutive lagoons. Fecal bacteria removal (due to amount of daylight) will be greatest in summer; in short-retention series lagoons, ss removal is not dependent upon the season. Conditions which favor the maximum removal of nitrate are the exposure of water to a maximal surface of mud. Removal rates up to 0.8 g N/sq m day are expected when denitrification is performed at the mud/water interface. Maximum phosphorus removal is possible when algae populations are at their maximum; their growth increases the pH of the water and causes precipitation of P as hydroxyapatite. While this algal growth occurs most rapidly during long (10 days or more) retention periods in single shallow lagoons in the summer, unacceptable ss and BOD may result. All of these findings are applicable to the "polishing" of almost fully nitrified effluents.

*Lagoons, *Sewage treatment, Suspended solids, Biochemical findings, Oxygen demand, Bacteria, Nitrates, Retention, Effluents, Waste water treatment, Phosphorus

D385
THE UNOX PROCESS--AN EXTENSIVE EXPERIMENT FOR THE BIOLOGICAL PURIFICATION WITH PURE OXYGEN--MUNICIPAL WATER PURIFICATION MUNICH (DAS UNOX VERFAHREN--EIN GROSSVERSUCH ZUR BIOLOGISCHEN ABWASSERREINIGUNG MIT REINEM SAUERSTOFF--STAD-WAESSERUNG MUENCHEN),

Martin, P., Schoenfelder, H., and Tischer, W.

Gas-und Wasserfach-Wasser/Abwasser, Vol. 116, No. 6, p 272-277, 1975. 7 fig, 1 tab.

Extensive experiments with the UNOX system developed by Union Carbide for biological waste water treatment are described. The waste water used for the experiments was composed of 60% domestic effluents with 40% effluents generated in food processing industries. The UNOX system is composed of closed reactors arranged in four stages, in which biological purification is achieved by the admission of air containing at least 95% oxygen. The purified effluent was of better quality than similar effluents treated by conventional methods for the same time period. The process was noted for its high stability with respect to load fluctuations, and a reduced production of excess sludge and solid matter. The UNOX system also offers hygienic advantages due to a reduction in air pollutant emissions.

*Biological treatment, *Waste water treatment, *Municipal wastes, Industrial wastes, Effluents, Oxygen

*High purity oxygen, *UNOX, Municipal-industrial wastes

D386
DEVELOPMENT OF THE DEEP AERATION TANK,

Fujii, H. K., Terasawa, K., Naito, I., and Takeshima, T.

Gesuido Kyokaishi, Vol. 12, No. 133, p 43-52, June, 1975. 6 fig, 6 tab, 6 ref.

A deep aeration tank with an aeration depth of 18 m was compared with one having an aeration depth of 4.2 m. An inner tank 1.0 m in diameter was used for liquid circulation for the latter case utilizing an air lift effect. The post aeration tanks consisted of four basins having an aeration depth of 4.5 m (water depth 5 m). Mixed liquid was sampled in glass cylinders after one hour of aeration and the liquid was allowed to stand for various periods of time. At an aeration depth of 4.2 m, the activated sludge in the mixed liquid settled almost completely after 30 minutes while at an aeration depth of 18 m, the activated sludge floated during the same period of time. The rate of flotation depended upon the quantities of activated sludge and air. Gases adsorbed on the floating sludge were analyzed by gas chromatography with a thermal conductivity detector. The gases contained up to 94% nitrogen. Good results were obtained at an aeration depth of 4.2 m for a BOD load of up to 100 kg/100 kg suspended solids per day.

*Aeration, *Tanks, *Suspended solids, *Waste water treatment, Gas chromatography, Activated sludge, Flotation

Deep aeration tanks

D387
DEVELOPMENT AND USE OF FLOATING FILTERING MATERIALS IN WATER FILTRATION (Razrabotka i vnedrenie plavayushchikh zagruzok fil'trovaniya vody),

Zhurba, M. G., Moroz, S. I., and Myagkiy, D. D.

Vodsnabzhenie i Sanitarnaya Tekhnika, No. 5, p 13-17, 1975. 2 fig, 3 tab, 6 ref.

Floating filtering materials and their uses are described. Polystyrene foam and lightweight aerated granules of originally compact materials are used as floating filter materials, arranged in filter tanks in one or more layers, or at one or more (usually two) levels. Floating filtering materials can be used for the purification of industrial and municipal waste water, and for the preparation of potable water from natural water. The suspended matter content in the water to be purified should not be greater than 500 mg/liter, and the rate of filtration should be between 0.6 and 2 m/hr. The granules of the filtering material should be 0.3-1.5 mm in diameter. The combined thickness of the filtering material arranged at two levels or in two layers is optimally between 0.7 and 1.2 m. Filtration rates over 20 m/hr are possible for drinking water preparation.

*Filtration, *Water treatment, *Waste water treatment, *Industrial wastes, Municipal wastes, Flotation, Tanks, Filters, Potable water, Suspended solids

Filtering materials, Polystyrene foam

D388
CENTRIFUGING PLANT IN THE PURIFICATION PLANT MUNICH-GROSSLAPPEN (ZENTRIFUGENLAGE IM KLAERWERK MUENCHEN-GROSSLAPPEN),

Tischer, W.

Abwassertechnik, Vol. 26, No. 3, p 23-24, 1975. 1 fig, 1 tab.

Full-scale experiments with a large-capacity Kloeckner-Humboldt-Deutz centrifuge used for sludge dewatering at the Grosslappen waste water treatment plant near Munich, Germany, are described. The existing digestors cannot cope with the 200 tons of primary and secondary sludge that are being generated daily. The demand for agricultural use of the sludge has decreased and the use of centrifuges for dewatering is a viable alternative to land application. With centrifugation, the dry matter content is increased from 3-10% to 20-30%. The water separated has a BOD5 level of 100-300 mg/liter. Flocculating polymers may be added directly into the centrifuge.

*Centrifugation, *Dewatering, *Sludge treatment, Waste water treatment, Treatment facilities, Polymers, Flocculation, Sludge disposal, Waste disposal

Munich (Germany)

D389
PURIFICATION OF URBAN WASTEWATERS BY ALKALINE PHYSICO-CHEMICAL TREATMENT (L'EPURATION DES EAUX RESIDUAIRES URBAINES PAR TRAITEMENT PHYSICO-CHIMIQUE ALCALIN),

Alexandre, D.

Techniques et Sciences Municipales--L'Eau, No. 6, p 239-247, 1975. 1 fig, 11 tab, 6 ref.

Alkaline physico-chemical waste water treatment and its advantages are described. Flocculation and subsequent clarification can be used as an autonomous process in place of biological waste water treatment. Flocculation is conducted at a pH of 11.5 in the presence of ferric chloride, aluminum sulfate, slaked lime, or polyelectrolytes. Aluminum sulfate, ferric chloride, slaked lime, polyacrylamide A22 (Purifloc), and powdered activated charcoal Acticarbone TE are used at rates of 20 g/liter, 10 g/liter, 35 g/liter, one g/liter, and 10 g/liter, respectively. The floccules obtained can be easily separated by decantation, and the dense sludge obtained can be disposed of onto landfills. The physico-chemical method is not inferior to biological methods in terms of BOD and COD reduction, and is even superior to the latter regarding disinfection and phosphate elimination. Physico-chemical treatment, requiring lower investment but higher operating costs than a biological system, offers the advantage of increased insensitivity to seasonal climatic and load variations.

*Waste water treatment, *Municipal wastes, Flocculation, Biochemical oxygen demand, Chemical oxygen demand, Operating costs, Capital costs, Waste disposal

*Physico-chemical treatment, Aluminum sulfate, Ferric chloride, Slaked lime, Polyacrylamide A22, Land application

D390
SEWAGE LAGOONS FOR FINAL TREATMENT, EXEMPLIFIED BY BAD HARZBURG (NACHKLAERTEICHE ZUR WEITERGEHENDEN ABWASSERREINIGUNG-DARGESTELLT AM BEISPIEL BAD HARZBURG),

Zander, K.

Wasser und Boden, Vol. 27, No. 5, p 119-121, May, 1975. 2 fig, 2 tab, 3 ref.

Operating experiences with sewage lagoons following biological waste water treatment at a facility in Bad Harzburg, West Germany, are presented. Four series-connected post-treatment lagoons with a total surface area of 23,000 sq m are necessary to handle wide fluctuations in the sewage load, which are a result of snowwater influx in the winter and an increase in the seasonal visitor population in the summer months. Water depth is adjustable between zero and 100 cm, and sewage has a residence time of one day in each lagoon. The lagoons were found to increase the efficiency of the entire biological waste water treatment plant from 97% to 99% in terms of BOD5 reduction. Potassium permanganate demand decreased from 58 to 48 mg/liter through the consecutive lagoons. COD values showed a reduction from 39 to 23 mg/liter, corresponding to a 40% reduction. The efficiency of the post-treatment lagoons in terms of nitrogen and phosphorus elimination amounted to 17% and 10%, respectively. The coli titer was reduced by 99%, and the lagoons had a healthy fish population.

*Lagoons, *Sewage treatment, *Biological treatment, *Waste water treatment, Chemical oxygen demand, Biochemical oxygen demand

Post-treatment lagoons, Sewage load fluctuations, Seasonal variations, Germany

D391
THE APPLICATION OF INCLINED TUBES OR PLATES TO SEDIMENTATION TANKS IN WASTEWATER TREATMENT,

Notes on Water Pollution, No. 68, March, 1975. 4 p, 19 ref.

The use of inclined tubes or plates in existing horizontal flow sedimentation tanks in order to increase the flow rate for solids removal has been investigated. These have been considered for sewage treatment facilities when the capacity of the facility has been exceeded by population increases, and extra sedimentation tanks have not been constructed to absorb the overloading. Inclined plates were originally produced commercially for the separation of oil and water and are still used for this purpose. While the installation of inclined tubes in existing horizontal-flow sedimentation tanks has been successfully done, the procedure is recommended only if the temperature of the influent is not significantly higher (by more than one degree C) than the bulk liquid temperature, and if the module can be washed down once every few weeks or provision is made for in situ cleaning to prevent growth of algae. From experiments, it was found that sloping tubes or plates are suitable for uprating overloaded humus tanks, but are not applicable for final settlement tanks in the activated sludge process. They are not suitable for tertiary treatment without the use of a flocculant. If such tubes or plates are to be used, the sedimentation tank should be designed on the basis of overflow rate using the total plan area of the plates. While the cost of installing sloping tubes is less than the construction of a new tank, the plastic tube module will last no longer than ten years. Thus this procedure is suggested only where temporary overloading is the problem where a new plant will be built during the following ten years, or when there is a severe limitation on availability of land space.

*Separation techniques, *Sewage treatment, *Waste water treatment, *Sedimentation rates, Installation, Economics, Tertiary treatment, Activated sludge, Biological treatment, Flow rates, Treatment facilities, Design criteria, Overflow

*Sedimentation tanks, Inclined tubes, Solids removal, Overloading

D392
DEFLUORIDATION OF WATER BY NALGONDA TECHNIQUE,

Nawlakhe, W. G., Kulkarni, D. N., Pathak, B. N., and Bulusu, K. R.

National Environmental Engineering Research Institute, Nagpur, India.

Indian Journal of Environmental Health, Vol. 17, No. 1, p 26-65, January, 1975. 8 fig, 22 tab, 21 ref.

A technique to remove excess fluorides from drinking water has been developed in India. The proposed method, called the "Nalgonda Technique", consists of the addition in sequence of sodium aluminate or lime, bleaching powder and filter alum to the fluoride water, followed by flocculation, sedimentation, and filtration. The method was investigated under laboratory conditions and then tested in the field. Such field studies included experiments in buckets and in drums (batch type) as well as in pilot plants (continuous type). The technique was seen to be effective in producing a clear water, with fluoride within permissible limits. The precise mechanism of fluoride removal was not understood, and it was due neither to adsorption nor to coprecipitation. The technique is adaptable to community water supplies, and the costs for defluoridation of water for individuals or communities is low enough so as to be feasible.

*Potable water, *Water treatment, *Fluorides, Pilot plants, Laboratory tests, Analytical techniques, Operating costs, Economics

*Defluoridation, *India, *Chemical treatment, Nalgonda technique

D393
CHICAGO'S SYSTEM OF SLUDGE TRANSPORT TO LAND RECLAMATION SITES,

Public Works, Vol. 106, No. 8, p 72, August, 1975.

Sludge removal from waste water treatment plants is being undertaken at two locations in the Chicago area. At the Lawndale Avenue lagoon facility, which serves as the storage area for sludge from the West-Southwest treatment works, sludge removal is handled directly by the Metropolitan Sanitary District of Greater Chicago. At the Calumet treatment works, the operation is being handled by private contractors. At each location, sludge is transferred from the lagoons to bulk carriers by submersible pumps placed directly in the lagoons. Sludge from Lawndale is discharged to barges on the adjacent Chicago Sanitary and Ship Canal, which will deliver it to a Fulton County site about 180 miles away. The dense sludge is moved to the barges by two Flygt CS-3300 pumps; mixers fluidize the sludge so that the concentration is under 8 percent. At the destination in Fulton County, each barge is unloaded by pumps and conveyed 11 miles for storage before land application. Sludge which has been stored in Calumet lagoons from 10 to 20 years is pumped out directly to railroad tank cars, each with a capacity of 20,000 gallons. The solids content of this sludge is more than 12 percent. A special rake blade traverses the lagoon and draws the sludge to the point of pumping at the lagoon edge. Four Flygt B-2250 submersible pumps are supported by a pier near the lagoon edge and hoses discharge to the tank cars through a pipeline 6700 feet long. Trains take the sludge daily to the Shawnee National Forest and to Arcola, Illinois, for disposal as fertilizer and soil conditioner.

*Sludge disposal, *Lagoons, *Treatment facilities, Sludge treatment, Transportation, Recycling, Pumps, Waste water treatment

Land application, Chicago (Ill)

D394
PROGRESS WITH THE DECARBONIZATION PROCESSES (FORTSCHRITTE IN DER VERFAHRENSTECHNIK DER ENTCARBONISIERUNG),

Flunkert, R., Pietzner, H., and Schiffers, A.

Vom Wasser, Vol. 43, p 467-494, 1974. 20 fig, 2 tab, 10 ref.

Advances in chemical and engineering technology have permitted the optimization of rapid decarbonization reactors. Practical experience with full-scale trials have confirmed the results of laboratory studies. Several interesting solutions, in terms of economics, have been identified. Rapid decarbonization is sometimes difficult to achieve. This has an adverse effect on optimum operation of the processes because of the sludgy characteristics of the precipitated carbonate of calcium. Mineralogic research has shown that the crystalline structure of calcium carbonate is very important. It is concluded that there are limits to large-scale rapid decarbonization.

*Calcium carbonate, *Water treatment, Potable water, Water softening, Equipment, Efficiency, Industrial water

Large-scale rapid decarbonization

D395
MIAMI PUSHES REGIONALIZATION TO KEEP PACE WITH POPULATION,

Ritsema, J. J.

Miami-Dade Water and Sewer Authority, Miami, Florida.

Water and Wastes Engineering, Vol. 12, No. 9, p 24-28, September, 1975. 2 fig, 3 tab.

The Miami-Dade Water and Sewer Authority has been expanding and regionalizing to keep up with the rapidly growing population of the area. The program is under the auspices of the Water Quality Management Plan (WQMP) for Dade County, Florida. The plan includes the expansion of the Virginia Key plant from 47 to 110 mgd, and the construction of 80 mgd and 50 mgd plants. A fourth regional waste water treatment plant (85 mgd) will be constructed in 1985. The Virginia Key plant is being expanded by the addition of aeration tanks, final settling tanks, and a 55 mgd pure oxygen activated sludge process without primary settling. Sludge will be processed by anaerobic digestion, heat treatment, dewatering, and use as a soil builder and landfill. The 80 mgd plant will use oxygen activated sludge. Some of the sewage that will be processed at this plant will be brackish due to salt water infiltration in the sewer lines. The sewage high in chlorides will be kept separate from the sewage low in chlorides, and the treatment plant units will be operated separately as saline or non-saline. Sludge from this plant will be treated at the Virginia Key facility. The 50 mgd plant will use a single stage oxygen activated process, sludge thickening, anaerobic digestion, heat treatment, dewatering, and sludge cake for soil building. Waste water disposal from the plants will be ocean outfall, injection wells, or reuse as cooling water..

*Waste water treatment, *Treatment facilities, Waste water disposal, Sludge treatment, Sludge disposal, Florida, Sewerage, Infiltration, Regional development, Activated sludge, Landfill

D396
THE CONSTANCE DRINKING WATER TREATMENT STATION-MODEL STUDIES AND OPERATING EXPERIENCES (DIE KONSTANZER TRINKWASSERAUFBEREITUNG-MODELLUNTERSUCHUNGEN UND BETRIEBSERFAHRUNGEN)

Barth, R., Lehn, H., and Mauz, J.

Vom Wasser, Vol. 43, p 117-125, 1974. 4 fig, 2 tab, 6 ref.

A new system for potable water purification was necessitated by the increasing amount of plankton in the depth of 40-50 meters of the Lake of Constance. The system consists of a rotating microfilter, the addition of unpressurized ozone, and a sand filter. The rate of filtration is 10 m/hr. This system was effective in laboratory tests performed from 1964 to 1966 and in a plant situation from 1968. A tissue of steel-threads, containing 230 holes per sq mm, is stretched over the microfilter. The holes form triangles, and within each triangle is a circle with a 23 mm radius. The zooplankton, most of the phytoplankton, and some bacteria are caught by the tissue. Two percent of the purified water is used to rinse the microfilter. This rinsing brings 90% of the raw-mass into the sewage canal. The remaining small plankton and bacteria are oxidized by ozone. The sand filter can be operated for long periods without cleaning. Cleaning uses 3.0% of the purified water and is performed about every six weeks. The small amount of purified water required for rinsing the microfilter and sand filter eliminates a large drain on the water supply.

*Water treatment, *Water purification, *Filtration, *Ozone, Filters, Foreign research, Potable water, Water supply

Microfilters, Sand filters

D397
EXPERIENCES WITH DRY FILTRATION OF WATER IN THE NORTH GERMAN LOW LAND (ERFAHRUNGEN MIT DER TROCKENFILTRATION VON WAESSERN DER NORDDEUTSCHEN TIEFEBENE),

Braeuer, H. W.

Vom Wasser, Vol. 43, p 237-245, 1974. 4 fig, 1 ref.

Dry filtration is described and the raw water supply in Northern Germany is characterized. Operating experiences with dry filters used in 7 water works and 14 pilot plants are discussed. The high solids-holding capacity, and the efficient filtration that can be achieved by employing dry filtration is demonstrated. The performance of these filters after backwashing, and the various operational applications are also discussed.

*Filtration, *Water treatment, *Filters, Water works, Pilot plants, Foreign research, Efficiencies

Dry filters, Germany

D398
BIN ACTIVATOR HELPS UPGRADE WATER PURIFICATION OPERATION,

Water and Sewage Works, Vol. 122, No. 8, p 68, August, 1975. 1 fig.

An automated system designed to discharge pebble lime from storage to a 10 mgd water purification process was installed in 1974 in the Kankakee Water Company's plant in Kankakee, Illinois. The automated system has reduced labor costs, provided additional storage space in the chemical building, and upgraded the general cleanliness of the facility. The system uses pebble lime stored in a wide bin, remote from the chemical building. A five foot Vibra Screw Bin Activator was installed on the storage bin to ensure successful operation of the new system and to eliminate bridging and packing. The bin activator is a vibrated bin bottom, replacing the converging bottom of a static bin, thereby removing the compacting area. The bin activator is flexibly attached by rubber fitted forged steel hangers and a bolted seal ring assembly to the enlarged opening formed by cutting off the bin bottom. Bin activator vibrations are isolated from the bin itself by the hangers. The ring assembly facilitates installation and eliminates field fitting and welding. An oil-lubricated and cooled Gyrator vibrates the bin activator and the material in the bin, while an integral vibrated baffle relieves the headload and transfers the vibrations to material far up in the bin. The material in the activator is thrown horizontally toward the discharge outlet, producing a constant flow of material.

*Water treatment, *Lime, *Equipment, Automation, Water purification, Mechanical equipment, Installation, Flow

Vibra Screw Bin Activator

D399
SANITARY LANDFILLS: NO PLACE FOR LEACHING,

Goeppner, J.

Richards of Rockford, Rockford, Illinois.

Water and Wastes Engineering, Vol. 12, No. 9, p 47-50, 53, September, 1975. 7 fig.

Zero discharge of leachate from the inactive Jeffco Sanitary Landfill in Jefferson County, Missouri, has been accomplished by a process which includes collection, secondary biological treatment, and land disposal. The leachate system comprises a leachate collection and conveyance system; an aerated facultative lagoon component; a pumping station; a force main; a surface ridge and furrow land irrigation system; and, a system of monitoring wells. Plastic pipe, installed two feet below the surface of the clay stratum, is used to collect leachate being generated along its entire length by gravity. An impervious plastic liner has also been inserted along the downhill sidewall and bottom of the construction trench. The aerated lagoon operates on the extended aeration principle utilizing a long detention time and a low ratio of organic loading. The expected overall removal of BOD is 85%. The secondarily treated effluent from the lagoon is discharged, using the ridge and furrow irrigation method, to a wooded ridge. An adjacent downslope eight-acre wooded area provides an additional infiltration area to prevent runoff from reaching a stream. Monitoring wells have been installed to determine the efficacy of the leachate collection and irrigation system, and to detect any detrimental effects on groundwater quality. The treatment facilities, pump station, and irrigation system are automatically operated. Total costs for acquisition, construction, and installation of the project were around $49,000.

*Waste water treatment, *Leachate, *Landfills, Water pollution control, Biological treatment, Waste water disposal, Irrigation, Waste disposal, Groundwater, Costs, Treatment facilities, Plastic pipes, Aerated lagoons

*Zero discharge

D400
POLYELECTROLYTES FOR POTABLE WATER TREATMENT,

Water Services, Vol. 79, No. 950, p 147-148, April, 1975.

Polyelectrolytes are being used as coagulant aids in treating water for a potable supply. Although polyelectrolytes have not completely replaced inorganic salts as primary coagulants, they have proven effective in removing color and turbidity from natural waters when up to 5 mg/liter of finely divided sodium montmorillonite clay was added to the water first. One of the advantages of using cationic polyelectrolytes as primary coagulants is a reduction in the amount of sludge produced. Another application of polyelectrolytes in the treatment of potable water is conditioning of sludge before dewatering. The addition of polyelectrolytes accelerates the thickening of sludge by sedimentation before final dewatering. Examples are given of the many uses of polyelectrolytes in potable water treatment. The use of polyelectrolytes instead of activated silica has resulted in lower treatment costs and better finished water quality. The toxic monomer acrylamide is used in the manufacture of some polyelectrolytes. These polyelectrolytes must meet the following specifications established by the U.S. Food and Drug Administration, the U.K. Department of the Environment, and similar agencies in other countries: no batch may contain more than 0.05 percent monomer acrylamide; the amount used must average no more than 0.5 mg/liter and never exceed 1.0 mg/liter; and, an upper limit for the content of monomer acrylamide must be stated by the supplier for every batch.

*Polyelectrolytes, *Potable water, *Water treatment, Coagulation, Sludge treatment, Turbidity, Specifications, Sludge, Water quality, Costs

Monomer acrylamide

D401
LOWER SPEED AERATORS CUT ENERGY USE,

Williams, G. F.

Bird Machine Company, South Walpole,
Massachusetts, Wastewater Treatment Equipment.

Water and Wastes Engineering, Vol. 12, No. 9, p 76-77, 79-80, September, 1975. 6 fig.

Very low speed (VLS) aerators for waste water treatment processes can lower the costs of energy while increasing the oxygen transfer efficiency. Oxygen transfer efficiency in surface aerators at a given power level has been improved by innovative impeller design, larger impellers and lower speeds. However, aerators of this type have a higher capital cost than high speed aerators. Low speed surface aerators are the best choice for activated sludge systems. New concepts of tip speed and pumping can be used to optimize the surface aerator design. Tip speed is only the tangential component of the mixed liquor discharge. Radial and vertical components must be added to the tip speed to determine the absolute discharge velocity from the blade. After design tip speed is chosen, the RPM and impeller size necessary to achieve the speed can be determined. It is advantageous to choose a large impeller diameter because of its higher pumping capacity. Mixing theory requires about five turnovers of a homogeneous fluid for complete mixing within the aeration zone. VLS surface aerators can achieve turnover in 6-10 min, for the same power, and increase actual oxygen transfer efficiency. The larger gear reducer and impeller required for VLS surface aerators increases the capital cost. However, the annual power cost savings effected by VLS aerators can offset the increased capital cost well within the usual industrial amortization time of three to five years.

*Waste water treatment, *Aeration, *Equipment, *Energy, Costs, Economics, Activated sludge, Capital costs, Impellers

Very low speed aerators

D402
ACTIVATED CARBON FIGHTS BAD TASTE,

Black, C. A., and Sulick, D. J.

Water and Wastes Engineering, Vol. 12, No. 9, p 70, 72, 74, September, 1975. 3 fig, 2 tab.

Granular activated carbon filters have eliminated taste and odor problems in the potable water supply of Granite City, Illinois. Filtrasorb 200 granular carbon was added to replace the sand in the city's eight filters. The filters were water soaked for one hour and then slowly backwashed to remove carbon fines. After the fines were removed, the backwash rates were increased to 10.5 gpm/sq ft, producing a 40% bed expansion at a minimum water temperature of 35 C. The conversion of the sand filters to carbon filters was finished early in February 1971. Daily threshold tests have shown that the activated carbon filters consistently produce an effluent with a threshold odor value of less than one, irrespective of fluctuations in the quality of the raw water supply. Routine analytical tests to determine the exhaustion rate of the carbon show that about one-half of the adsorption capacity of the carbon has been used. Chlorinated hydrocarbons, phenols, pesticides, insecticides, and aromatic compounds are adsorbed by the carbon filters. The filters have also increased the removal of suspended solids while maintaining the filter head loss to a minimum. The lower backwash rate used with the carbon filters as compared to the rate necessary with the sand filters has resulted in a savings of backwash water.

*Water treatment, *Activated carbon, *Taste, *Odor, Potable water, Water quality, Filtration, Suspended solids, Organic compounds

Filtrasorb 200 granular activated carbon

D403
WE MUST IMPROVE CHLORINATION DESIGN,

Robson, C. M., Hyatt, B. S., Jr., and Banerji, S. K.

MCA Engineering Corporation,
Baltimore, Maryland.

Water and Wastes Engineering, Vol. 12, No. 9, p 61-66, 68, September, 1975.

More stringent standards for the disinfection of waste water necessitates the improvement of chlorination practices. Recent standards concerned with virus inactivation call for free residual chlorine levels after one hour of 0.5 mg/liter to 3.0 mg/liter. The most commonly used method of measuring residual chlorine is the orthotolidine method. The amperometric titration method, based on an oxidation reduction procedure, is becoming more commonly used for waste water. Factors affecting the efficiency of the disinfection process include the quality of the influent to the disinfection process, temperature, pH, turbidity, and the presence of materials which exert a chlorine demand. The most important parameters in chlorination are rapid initial mixing, adequate contact time, and a workable automatic chlorine residual control system. Mixing in a chlorine system must be rapid; the ideal mixing time is a fraction of a second. An equation to predict the efficiency of chlorine disinfection is discussed, and a means of statistically analyzing the data from dye testing of contact chambers is illustrated. The most significant factor in the configuration of a chlorine contact chamber has been analyzed to be the length-to-width ratio. Current research on the effects of chlorine residuals on the aquatic environment has demonstrated the need for dechlorination. Sulfur dioxide, sodium bisulfite, sodium sulfite, sodium metabisulfite, and granular activated carbon can be used for dechlorination.

*Waste water treatment, *Disinfection, *Chlorination, Chlorine, Mixing, Analytical techniques, Measuring, Equipment

D404
HARDNESS REMOVAL BY ION EXCHANGE WITH A RECOVERABLE ORGANIC REGENERANT,

Johnson, G. V.

Dissertation Abstracts International B, Vol. 36, No. 2, p 873-874, 1975.

Currently sodium cycle ion exchange regenerant effluents are discharged, without treatment, directly to sewer systems or natural waterways. Because these effluents contain excessive concentrations of dissolved solids, particularly calcium and magnesium, it is expected that such discharge will soon be prohibited under the Federal Water Pollution Control Act. Alternative disposal methods or removal of hardness-causing ions were investigated, particularly the possibility of a water softening process involving regenerant reuse. The treatment system consisted of removing hardness-causing ions by ion exchange, using glucosamine as a recoverable organic regenerant, and subsequently concentrating the eluted glucosamine for reuse by means of an ultrafiltration membrane system. Calcium and magnesium were exchanged on a cation exchange resin in a glucosamine cycle, and an effluent with a glucosamine concentration of 3000-3500 mg/liter, initial breakthrough volume of 2000 ml, and initial specific treatment capacity of 650 gal/cu ft of resin was produced. A confirmation process for cyclic reuse of the glucosamine regenerant was performed, with the use of a membrane recovered glucosamine concentrate to regenerate the ion exchange column. A net result of achieving the same degree of regeneration previously attained with unused glucosamine was found.

*Ion exchange, *Effluents, *Waste water treatment, *Recycling, Sodium, Calcium compounds, Magnesium compounds, Hardness (water), Organic compounds, Membrane processes

*Glucosamines, Regenerants, Ultrafiltration

D405
FUNDAMENTALS OF ELIMINATING ORGANIC WATER POLLUTANTS WITH POLYETHYLENE (GRUNDLAGEN DER ELIMINIERUNG ORGANISCHER WASSER-BELASTUNGSSTOFFE MIT POLYAETHYLEN),

Weil, L., and Greiner, G.

Vom Wasser, Vol. 43, p 247-257, 1974. 2 fig, 5 tab, 10 ref.

Waste water samples containing organic pollutants were treated on a laboratory scale to produce potable water in a flocculation plant with an hourly throughput of 400 cu m. Similar treatment was given to slightly polluted groundwater and bank-filtered river water for comparison. Polymer substances were added to the organic compounds before flocculation; these polymers were an emulsifier-free dispersion of a copolymer of ethylene and vinyl acylamide. Because the disperse plastic had a particle size of only 0.5 micrometers, short contact times were possible. Results indicated that lipophilic organic compounds (such as chlorinated insecticides, petroleum spirit, and crude oil) were removed far more efficiently from the waste water with polyethylene powder than with conventional chemical treatment methods. The addition of the polymer can be implemented in existing treatment facilities without adding further processing stages. Possibilities of applications and economics of the method are discussed.

*Organic compounds, *Flocculation, *Oil, *Waste water treatment, *Polymers, Polyelectrolytes, Potable water, Adsorption, Laboratory tests

D406
MOTIONLESS MIXERS IMPROVE OXYGEN TRANSFER EFFICIENCIES, PART I,

Hsu, K. H., Erickson, L. E., and Fan, L.

Water and Sewage Works, Vol. 122, No. 8, p 76-79, August, 1975. 6 fig.

Effects of various types of motionless mixers on oxygen transfer efficiencies are discussed. A multistage cocurrent sieve tray tower system and a cocurrent column packed with Koch mixers were studied. The multi-stage tower type activated sludge process was more efficient than any other known activated sludge process. A bubble column and a six-stage perforated plate column were applied to activated sludge treatment. Sludge in the bubble column caused bulking while sludge from the six-stage perforated plate column had good settling properties. The Koch mixer column removed COD as efficiently as the sieve tray column. Both mixers experienced wall growth by the organisms.

*Chemical oxygen demand, *Activated sludge, *Biological treatment, Waste water treatment, Mixing, Equipment, Microorganisms

*Oxygen transfer, *Motionless mixers, Koch mixer

D407
LAND DISPOSAL OF WASTEWATER IN HAWAII,

Dugan, G. L., Young, R. H. F., Lau, S. L. Ekern, P. C., and Loh, P. C. S.

Hawaii University, Honolulu, Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 8, p 2067-2087, August, 1975. 4 fig, 8 tab, 11 ref.

Determination of the feasibility of applying secondary treated waste water effluent to selected land areas on the island of Oahu, Hawaii, is discussed. Grassland and sugarcane culture were irrigated with waste water effluent to ascertain the probable effects on groundwater quality, particularly in terms of dissolved solids and enteric virus transmission and survival. Also, the total sugar cane production and purity were determined for sugar cane cultured in test plots receiving waste water effluent. A combination of grass and soil removed almost all detectable amounts of nitrogen and phosphate from waste water effluent, and between 90 and 95 percent of TOC, suspended solids, and boron. Sugar cane fields showed the same general results. Human enteric viruses were found to have generally survived secondary waste treatment. However, the soil was effective in removing the viruses from the secondary effluent.

*Waste disposal, *Irrigation, Drainage, Sugarcane, Grasslands, Nutrient removal, Viruses, Recycling, Effluents

*Waste reuse, Land application, Oahu (Hawaii), Enteric viruses, Total organic carbon

D408
EXPANDING A 1927 WATER PLANT FOR THE 1970S,

Seidel, H. F., and Cleasby, J. L.

Ames, Iowa, Water and Pollution Control.

Public Works, Vol. 106, No. 8, p 54-57, August, 1975. 4 fig.

The development of the present Ames, Iowa, water treatment plant is discussed. In 1932, construction began on a new softening plant, to replace the small system that had evolved up to that time. A leading expert on softening was consulted and a plant with a two stage softening process, using lime and soda ash in one stage, and recombining sludge as a seeder for the second stage was constructed. In the 1950's, single stage treatment was experimented with to increase hydraulic capacity. In 1962, this single stage plan was implemented. The latest changes were made in 1971. Over the years a highly flexible, responsive modern treatment plant has been developed, with a minimum of gadgetry and automatic controls and thus a minimum of control and equipment maintenance.

*Water treatment, Hardness (water), Filtration, Treatment facilities, Construction

Ames (Iowa), Lime-soda ash softening

D409
UPGRADING HIGHWAY SERVICE AREA WASTEWATER TREATMENT PLANTS,

Sander, I. P.

Public Works, Vol. 106, No. 10, p 70-72, October, 1975. 1 fig.

Waste water treatment plants and center supply sources operated at highway service areas by the New York State Thruway Authority are discussed. Of 28 service facilities now in use, 27 are served by 24 Authority-owned waste water treatment plants. In 1964, with the aid of a consulting firm, the water and waste water facilities were surveyed and recommendations for modifications were made. During the past ten years, five primary waste water treatment plants were converted to secondary treatment and others have been enlarged and improved. The Malden area about two hours from Metropolitan New York has encountered an unanticipated increase in peak daily flow. While the 1964 survey predicted a peak flow of 47,000 gpd, by 1972 the flow rate for 24 hours was 86,000 gallons. The plant was therefore redesigned, placing an aerated holding tank in the flow scheme following comminution. This allowed a constant flow to be maintained in the primary clarifier so that the unit could function most efficiently. A plastic media packed bed reactor was later added and results were very satisfactory. Treatment plants along the Thruway are generally manned by a single operator, and chlorine handling was made relatively safer by the use of small chlorine containers of about 40 pounds. The summer patronage of the service areas is higher than in the winter and the chlorine containers must be changed more frequently. For each waste water treatment facility, the Authority has National Pollution Discharge Elimination Permits (NPDES) and the update or upgrading of the facilities will be conducted in order to comply with discharge standards.

*Waste water treatment, *Water supply, *Treatment facilities, *Sewage treatment, Flow rates, Clarification, Chlorine, Standards, Highways

Highway service facilities, New York State Thruway Authority

D410
PRECAST CONCRETE PILES CUT PLANT CONSTRUCTION COST,

Hennigan, J. J.

Onondaga County, New York,
Department of Drainage and Sanitation.

Public Works, Vol. 106, No. 10, p 84-85, October, 1975. 1 fig.

While the decision to provide secondary treatment of municipal and industrial waste water at the Metropolitan Syracuse Treatment Plant was made in 1965, several problems have delayed construction of the 83-mgd plant for over ten years. Preliminary studies were required, including an in-depth study of Onondaga Lake, a survey of the waste discharges of 140 industries which discharge to the sewer system, and associated investigations of joint municipal-industrial waste treatment feasibilities. The 1972 Amendments to the Water Pollution Control Act necessitated the adherence to new requirements, including infiltration/inflow studies, environmental impact and assessment statements, and public hearings. The final problem was the cost of steel products, in particular the required 1,125,000 linear feet of piping. Due to steel shortages and excessive prices in the summer of 1974, precast concrete piles were considered as an alternative. These prestressed concrete piles were eventually chosen, after the testing of a splice capable of taking tension. The price of construction, using the prestressed concrete piles rather than those of steel, was $86.7 million, about $22 million less than the original engineering estimate.

*Construction materials, *Construction costs, *Treatment facilities, Costs, Environmental effects, Concrete technology, Waste water treatment, Industrial wastes, Sewer systems

Onondaga Lake (NY)

D411
WHAT'S NEW IN WATER TREATMENT?,

Fairweather, V.

Civil Engineering-ASCE, Vol. 45, No. 9, p 69-72, September, 1975. 2 fig, 2 tab.

Various assessments of existing standards for potable water were reviewed, partially due to the discovery of potential carcinogens in the New Orleans, Lousiana, water. The largest controversy was on the use of chlorine both at the waste water treatment plant and at the water treatment facility, which may combine with trace organics to form the potential cancer-causing compounds. The two alternatives appeared to be the removal of all possible organics or the elimination of chlorine treatment. Removal of organics by ozone or by activated carbon treatment have been considered. Two proposed standards under discussion were the stringent turbidity standard (1.0 TU) and the Carbon Chloroform Extract (CCE) standard (0.7 mg/liter). The CCE test, which reveals the presence of organic compounds absorbed by carbon, has been criticized as being too broad to be meaningful. It is possible for a water supply to have a high CCE and not contain any carcinogens; it also feared that a water supply with low CCE may contain carcinogenic matter. Other issues under discussion included the advantages of polymer use over alum as a coagulant; the advantages and disadvantages of direct filtration; and recovery and reuse of alum in sludge disposal. With the implementation of the Safe Drinking Water Act last year, costs of public health will be more carefully considered in the meeting of final standards.

*Water treatment, *Potable water, *Legislation, *Standards, *Chlorine, Ozone, Activated carbon, Polymers, Coagulation, Filtration, Costs, Public health, Turbidity

Carbon Chloroform Extract, Safe Drinking Water Act, Carcinogens

D412
NITRATE REMOVAL BY ANION-EXCHANGE RESINS,

Buelow, R. W., Kropp, J. W., Withered, J., and Symons, J. M.

National Environmental Research Center, Cincinnati,
Ohio, Water Supply Research Laboratory.

American Water Works Association Journal, Vol. 67, No. 9, p 528-534, September, 1975. 3 fig, 9 tab, 11 ref.

High concentrations of nitrate in drinking water obtained from groundwater can cause serious illness or death. An ion exchange process has been developed using a nitrate selective resin which can remove low concentrations of nitrate. A laboratory study was conducted: to test the selectivity of the resin; to test the performance of the resin when there are high concentrations of nitrate and other anions; to determine the influence of specific ions on resin performance; and to determine the economic feasibility of the process. Other ions used in the study were bicarbonate, silica, chloride, sulfate and iron. In small concentrations the resin shows a preference towards exchange of nitrate over sulphate and other ions, but at higher concentrations, the resin shows a preference for sulfate. In both hard and soft well water, nitrogen removal by the resin was decreased to 26.5% of base capacity. Iron precipitated and caused a fouling problem in the exchange. In studying the influence of specific ions on nitrate removal, it was found that silica reduced nitrate removal to 67.5% of base capacity, sulfate reduced it to 40 to 43.6%, sulfate plus alkalinity reduced it to 33.3%, and sulfate plus alkalinity plus chloride reduced it to 28.2%. Regeneration of the resin in the water was made possible by the addition of sodium chloride. This process becomes more feasible around a coastal area where there is an abundance of salt water. The cost of nitrate removal varies considerably with the quality of water, based mainly on the salt requirement.

*Nitrates, *Anion exchange, *Ion exchange, Potable water, Waste water treatment, Pollutant identification, Economic feasibility, Resins, Selectivity, Chemical analysis, Water pollution treatment, Chemical precipitation, Water treatment, Groundwater, Iron

D413
CONTRACTOR TEAMS TOUCH ALL BASES BUILDING WATER-SIDE SEWAGE FACILITY,

Drossel, M. R.

McGraw-Hill World News, San Francisco, California.

Construction Methods and Equipment, Vol. 57, No. 9, p 40-43, September, 1975.

Work on the Oakland, California, East Bay Municipal District sewage treatment plant is discussed. The project cost $56 million. Cost saving aspects included concrete conveying and gangforming for a dozen settling tanks, compartmentalized oxygenation tanks and four sludge digester tanks; tank-riding, self-propelled scaffolds; an outfall pipe submerging and placing system featuring a hydraulic hoist, laser alignment and force-fed rock bedding; and specially grouted and doweled piling. Three settling tanks were built at a time, each one taking 16 days to complete. The four sludge tanks were built in 10 weeks. Laser alignment of a 624 ft addition to an eight foot diameter outfall piping permitted work to proceed in the fog and in the murky waters of Oakland Bay. A premixed non-metallic grout for the securing of the dowels at the tops of the piles was also used to cut installation costs.

Construction materials, Treatment facilities, Construction costs, Grouting, Oxygenation, Sludge digestion, Waste water treatment

Oakland (Calif), Laser alignment, Hydraulic hoist, Scaffolding

D414
ALUMINUM AND WATER TREATMENT. THE "GULDAGER" ELECTROLYTIC PROCESS (L'ALUMINIUM ET LE TRAITEMENT DES EAUX. LE PROCEDE ELECTROLYTIQUE "GULDAGER"),

Schaefli, H., and Grossenbacher, R.

Revue Suisse de l'Aluminium, No. 5, p 128-129, May, 1975. 7 fig.

The "Guldager" electrolytic system developed for corrosion and scaling prevention is described. The tank of the installation to be protected is provided with a pure aluminum plate serving as an anode connected to a d.c. source, while the tank proper serves as a cathode connected with the negative pole of the d.c. source. The rectifier voltage applied is between 10 and 25 Volts, and the current density varies from 100 to 400 mA/sq cm as a function of the water composition. The d.c. current flowing through the water counteracts the corrosion current; therefore, the tanks and heating surfaces are cathodically protected. The pipelines are protected against corrosion due to the aluminum anodes emitting colloidal aluminum hydroxide which forms protective layers in thicknesses up to 1-2 mm. Calcium carbonate scaling is prevented by the aluminum hydroxide particles encapsulating the carbonate particles. The carbonate coated with aluminum hydroxide settles on the tank bottom for easy removal.

*Corrosion control, *Water treatment, *Equipment, *Aluminum, Tanks, Electrolytes, Cathodic protection

Guldager process

D415
EXTENDED WASTE WATER PURIFICATION IN A GROUP SEWAGE PLANT AS PROTECTIVE MEASURE FOR A LEAK (WEITGEHENDE ABWASSERREINIGUNG IN EINEM GRUPPENKLAERWERK ALS SEENSCHUTZMASSNAHME),

Lanowy, T.

Vom Wasser, Vol. 43, p 193-214, 1974. 12 fig, 4 tab, 11 ref.

When water, which was originally impounded for flood protection and energy generation, is used for drinking purposes, it is necessary to reorganize the water and sewage policies in the catchment area of the impounding reservoir and to solve numerous sanitation problems. These problems are discussed with reference to the catchment area of the Bystrzyca river and the Lubachow reservoir in Poland. The intended reorganization of water uses will involve: construction of a group sewage plant for about 15000 cu m waste water/day, including a collector to direct the water around the reservoir; construction of a plant for the treatment of impounded water intended for industry located in the neighborhood of the river basin; incorporation of artificial aeration of the reservoir; and construction of an extensive sewage purification plant from which water can be fed into the reservoir when the flow of main tributary water is low. Since the waste water to be handled contains more than 62% industrial effluent from dye-house works, tanning factories, spinning mills, and other factories, considerable difficulties will be met in its treatment, particularly with regards to decoloration. The results of investigations carried out in an experimental sewage purification plant as well as the potentiality of recovering drinking water with the aid of ion-exchange, electrodialysis, and activated charcoal filtration processes are discussed. A detailed program of industrial investigations is needed to find the optimum sewage purification process.

*Waste water (pollution), *Water purification, *Sewage treatment, Flood protection, Potable water, Treatment facilities, Waste water treatment, Industrial wastes

*Bystrzyca river (Poland), *Lubachow reservoir (Poland), Sanitation problems, Municipal-industrial wastes

D416
SAND FILTER AND WASTE STABILIZATION POND TEST SHOWS POSSIBILITY FOR TREATMENT OF INDIVIDUAL WASTEWATER DISPOSAL,

Beard, M. L., and Lawrence, C. H.

Grants, New Mexico,
Division of Indian Health.

Journal of Environmental Health, Vol. 38, No. 1, p 43-44, July/August, 1975. 1 tab, 10 ref.

In order to determine whether or not waste stabilization ponds and sand filters are capable of treating individual dwelling or housing cluster wastes to a level of effluent superior to the conventional septic tank, four such ponds and four such filters were sampled. Bacteriological, chemical, and biochemical analyses were made for each system. A wide range of loading conditions were chosen and each unit was sampled weekly for one month. Sand filters were 20 ft by 40 ft by 4 1/2 ft and were preceded by sedimentation in conventional septic tanks. The waste stabilization ponds served households receiving untreated well water and each was also preceded by a septic tank for sedimentation. Effluent samples from all eight units were analyzed using Standard Methods for BOD, COD, nitrates, and fecal coliform. The sand filters produced better BOD, COD, and suspended solids levels than did the waste stabilization ponds. However, the performance of the ponds was better in terms of producing a much lower nitrate concentration and low levels of effluent fecal coliform. It was concluded that both types of units meet Federal effluent standards and do provide a suitable alternative to the conventional septic tank system for disposal of domestic waste water.

*Waste water treatment, *Septic tanks, Biochemical oxygen demand, Chemical oxygen demand, Nitrates, Coliform, Effluents, Standards

*Sand filters, *Waste stabilization ponds

D417
THE DEGRADATION OF ORGANIC POLLUTANTS IN WATER BY OZONE (UEBER DEN ABBAU VON ORGANISCHEN SCHADSTOFFEN IM WASSER DURCH OZON),

Gilbert, E.

Vom Wasser, Vol. 43, p 275-290, 1974. 14 fig, 6 tab, 8 ref.

In water with an initial pH of 5, ozone is used in the oxidative degradation of monochlorophenols, dichlorophenols, 2,4,6-trichlorophenol and 2,3,4,5-tetrachlorophenol. The process dechlorinates and breaks up the aromatic ring. Organic chlorine is converted to chloride, with the yield of the resulting chloride being between 60 and 95% of the theoretical value. The yield is dependent upon the position of the chlorine atom with respect to the OH-group and 3.5 to 5 moles of ozone are needed for the complete degradation of one mmole of chlorophenole, corresponding to an ozone consumption of 50 to 60%. The oxidation products were seen to be biodegradable. The oxidation of 2,4-dichlorophenol was not affected by glucose, deoxyribose or glutamic acid.

*Ozone, *Chlorine, Phenols, Waste water treatment, Waste treatment, Oxidation, Organic compounds, Biodegradation

D418
UNOX SYSTEM PILOT PLANTS-TWO YEARS' EXPERIENCE WITH PURE OXYGEN IN THE ACTIVATED SLUDGE PROCESS,

Steen, D., and Fuggle, R. W.

The Public Health Engineer, No. 16, p 91-104, July, 1975. 4 fig, 8 tab, 7 ref.

Three UNOX pilot plant programs have been conducted at three English sewage treatment works, Ray Hall, Birmingham; Slack's Valley, Oldham; and Saltford, Bath. Schematic diagrams are presented for the multistage UNOX system, the mobile pilot plant, and the two-stage system tested. Summaries of the performance of each of the pilot plants are discussed, and several conclusions are made from the results of the studies. UNOX plants are capable of operating with high concentrations of suspended solids and short retention times. Under these conditions, the effluents produced will still contain low BOD and suspended solids (SS) concentrations. A fully nitrified effluent has been obtained by using air aeration following the high rate removal of carbonaceous material by a UNOX system. Problems in achieving nitrification at one of the facilities was due to the presence of toxic substances and a low pH. Using pure oxygen for sewage treatment has maintained thick under flow concentrations for the settling basins except when the sewage contained high concentrations of filamentous organism. The UNOX system has operated without problems when sewage treated contained quantities of filamentous organisms that normally cause sludge bulking in air systems. The activated sludge in UNOX system has a rapid settling rate which shows little effect from sludge loading variation.

*Activated sludge, *Waste water treatment, *Sewage treatment, *Treatment facilities, Pilot plants, Oxygen, Sludge

UNOX, High-purity oxygen activated sludge

D419
SECONDARY TREATMENT AT LONG REACH,

Williamson, F. D.

The Consulting Engineer, Vol. 39, No. 8, p 31, 33, August, 1975.

Work on the third and final stage of the extensions to Long Reach Sewage Treatment Works (England) has been initiated. This final stage will provide secondary treatment and improve sludge treatment and disposal, and is an important step in further reducing the pollution of the Thames estuary. The new plant will treat a dry weather flow of about 35 mgd. Secondary treatment is expected to reduce the effective oxygen demand (eod, a parameter that expresses the amount of oxygen required to oxidize both carbonaceous and nitrogenous substances in the effluent) by about 60%. Six aeration tanks are to be added together with associated liquor, settled sewage and return activated sludge channels. Provisions are being made for two additional tanks. Each tank will be 80 m by 26.3 m by 4.4 m. Diffused air will be used to aerate the mixed liquor. Three motor driven turbo-blowers are being installed, with provision for two more. In order to reduce the chances of cracking of concete due to shrinkage, construction of the floor and walls of the facility will be performed in short "L"-shaped sections. Construction of a given section of a floor will be followed as soon as possible by construction of the corresponding wall section, so that shrinkage of the floor and wall will occur at the same time.

*Sewage treatment, *Waste water treatment, *Treatment facilities, Activated sludge, Construction, Aeration

Secondary treatment, Long Reach Sewage Treatment Works (GB)

D420
FACTORS TO CONSIDER WHEN SELECTING GRANULAR ACTIVATED CARBON FOR WASTEWATER TREATMENT,

DeJohn, P. B.

ICI America Incorporated, Wilmington, Delaware.

In: Proceedings of the 29th Industrial Waste Conference, May 7-9, 1974, Part Two, Lafayette, Indiana, Purdue University, p 790-807. 14 fig, 12 tab.

The selection and use of granular activated carbon in waste water treatment were studied. Before selecting a carbon type, an analysis of cost is advisable; it should be made through a minimum of five adsorption-regeneration cycles. Performance deterioration and price differences between the two carbon types should also be kept in mind. The choice of a granular activated carbon should be based on its meeting effluent standards through impurity adsorption, on moderate losses during regeneration, on minimal pressure drop, absence of operating problems, and on the most economical operating cost. Adsorption data reveals that lignite carbon will be more efficient in dealing with waste water streams which contain pollutants with mostly large molecules while bituminous coal carbon will be preferable when working on streams with predominantly small molecules. In domestic waters, both carbons should give equivalent results. Regeneration data shows that lignite carbon regenerates more easily and under less severe conditions because of its larger pore structure and its greater inert ash content.

*Waste water treatment, *Activated carbon, Lignite, Coals, Bituminous materials, Adsorption, Molecular structure

Bituminous coal carbon

D421
OZONE DEGRADATION IN PACKED COLUMNS,

Kessick, K. A., and Matson, J. V.

Rice University,
Houston, Texas,
Department of Environmental Science and Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 101, No. EE5, p 883-886, October, 1975. 2 fig, 4 ref.

Ozone has been considered as an alternative disinfectant to chlorine in water and waste water treatment systems. One hazard of ozone treatment is an unacceptable level of gas that might be released to the atmosphere. To minimize this problem, ozone may be adsorbed into potassium iodide solution, thermally degraded in a flare, or decomposed in a packed column. The last of these procedures was evaluated by reaction zone analysis. Destruction of ozone was carried out for both dry and water-saturated gas streams. Carbon column packings of 21-g (48-ml bed volume) dried Pittsburg Activated Carbon Type SGL 8-30 were used. For purpose of comparison, Linde Molecular Sieve type 13x, a zeolitic material, was evaluated by the same method for ozone decomposition ability. The activated carbon in a packed column demonstrated a performance markedly superior to that of the zeolite. The use of the carbon column was suitable for the continuous removal of small percentages of ozone from a wet or dry gas stream. Carbon was irreversibly degraded at the rate of approximately one g/4 g ozone destroyed. The weight loss (about 0.35 g/4 g ozone destroyed) indicated that a catalytic or thermal mechanism as well as a chemical reaction had contributed to the degradation.

*Ozone, *Waste water treatment, *Chlorine, *Adsorption, Activated carbon, Zeolites

Packed columns, Ozone decomposition

D422
SANITARY SURVEYS AND SURVIVAL CURVES OF SEPTIC TANK SYSTEMS,

Winneberger, J. T.

Journal of Environmental Health, Vol. 38, No. 1, p 36-39, July/August, 1975. 1 fig, 2 tab, 6 ref.

An argument is presented in favor of reviewing presently operating septic tank systems rather than arbitrarily replacing them with sewers. It is believed that many federally funded sewerage projects have been unnecessary, and have led to urbanization of reluctant communities. Two unincorporated communities in California are compared, both with the same terrain and the same septic-tank practices. One had small, city-size lots and the other had larger lots. While septic tank problems in the city with the small lots were immediately realized when sewage spilled into a neighboring property, in the case of the large lots, nuisances were less often noticed. Survival curves and failure rates for the two systems were compared, and it was found that the small lots had a 17% failure, while the large lots had a failure rate of 15%, or about the same. The survival curves indicated that about 50% of the systems survived 25 years. This rate is deceptive, because the types of repair and amounts of time for the septic tank to again be operable vary. It was recommended that further sanitary surveys be conducted and that the choice of building sewer systems rather than improving septic tanks be re-evaluated.

*Septic tanks, *Surveys, *Sewers, *Sewerage, Public health, Costs

Septic tank survival curves

D423
DEVELOPMENTS IN BACKWASHING OF GRANULAR FILTERS,

Cleasby, J. L., Stangl, E. W., and Rice, G. A.

Iowa State University, Ames, Civil Engineering and
Engineering Research Institute.

Journal of the Environmental Engineering Division, Vol. 101, No. EE5, p 713-727, October, 1975.

Three methods of backwashing granular filters are evaluated. The effectiveness of: water fluidization only; air-scour followed by water backwash; and surface wash before and during water backwash were tested when filtering different types of waters. Previous studies have shown that the cleaning of granular filters by the upward flow of backwash water alone to fluidize the filter bed is a weak method because particle collisions do not occur in a fluidized bed. Therefore, auxiliary means of improving filter bed cleaning are employed. Experimental testing involved the utilization of three different filters operated in parallel, the filtering of water later followed by two different waste waters, sampling of influent and effluent flows, readings of turbidity and head loss, standard abrasion testing of core samples taken from the media after the backwash, and visual observation. Results support findings on the weakness of water fluidization only, and consolidate the advantages of the auxiliary methods in maintaining the filters in better condition. It was also found that heavy mud ball concentrations are undesirable since they increase initial head losses and help shorten filter cycles; filter cracking will let solids penetrate deeper into the filter and may lower filtrate quality in some instances. Proper backwashing with the auxiliary methods necessitates the expansion of the coals and sands usually specified in dual and mixed media filters. Air-scour systems are described which require special attention in design and utilization.

*Water treatment, *Filtration, *Filters, Equipment

Backwashing, Filter cleaning

D424
GREATER VANCOUVER OPENS ANNACIS TREATMENT PLANT,

Matheson, G.

Water and Pollution Control, Vol. 113, No. 9, p 14-16, September, 1975.

Greater Vancouver (British Columbia) Regional District's recently opened Annacis Island Sewage Treatment Plant is presently providing primary treatment while the Frazer estuary is being tested for possible secondary treatment. The plant is mainly concerned with the elimination of pathogens and toxicity to fish and with the preservation of the estuary's aesthetic qualities rather than with the maintenance of low nutrient levels. Designed to serve 490,000 people by 1986, it is also highly automated; an older plant would employ one man per one mgd while the Annacis Island plant uses one man per three mgd. The processes involved in primary treatment comprise influent sampling, pre-chlorination, screening, pumping to preaeration and grit removal, followed by thickening, high rate digestion, and drying and storage in sand-dyke lagoons; grit and scum dewatering; post chlorination in contact tanks with de-chlorination; and effluent sampling, metering and discharge through an outfall fitted with diffusers. Operating costs are divided among the eleven municipalities according to the value of real property in the collection districts.

*Waste water treatment, *Sewage treatment, *Treatment facilities, Automation, Canada, Dewatering, Chlorination, Operating Costs, Personnel

D425
PROCESS CLOSES LOOP ON SEWAGE TREATMENT,

Chemical and Engineering News, Vol. 53, No. 40, p 6-7, October, 1975.

A pilot plant is to be built in southern California which will test a new treatment process whereby solids in the sewage are converted to activated carbon. These are in turn utilized to treat the incoming waste water. The plant will be a magnification of an already existing mobile unit where the treatment process almost completely eliminated sewage solids, produced clean waste water and removed odors and heavy metals in the sewage. It is expected that the process will exceed EPA standards at a lower cost.

*Sewage treatment, *Waste water treatment, *Pilot plants, Activated carbon, Heavy metals, Suspended solids, Standards, Costs

D426
ADSORPTION OF INORGANIC MATERIALS ON ACTIVATED CARBON,

Nelson, F., Phillips, H. O., and Kraus, K. A.

Oak Ridge National Laboratory, Oak Ridge, Tennessee.

In: Proceedings of the 29th Industrial Waste Conference, May 7-9, 1974, Part Two, Lafayette, Indiana, Purdue University, p 1076-1090. 20 fig.

Recent experiments dealing with adsorption phenomena typical of activated carbon are reviewed. The relative extent of anion and cation uptake is determined by means of the 'double tracer technique' and as a function of pH. Small columns are pre-equilibrated with the electrolyte solutions. A solution of the same composition but which contains the appropriate tracer is then passed through the column bed and the effluent is monitored for appearance of the tracer. If the kinetics of exchange is satisfactory, a typical, symmetrical breakthrough curve is obtained. The greater part of the study made use of either commercial, powdered activated carbon Aqua Nuchar A or of a granular coconut charcoal. Most analyses were made radiometrically with appropriate gamma emitting isotopes or by standard atomic methods. Alkali metal separations demonstrated cation exchange properties found at high pH and to a certain extent in neutral solutions of activated carbons. Secondly, the uptake of electrolytes from neutral and slightly acidic solutions was illustrated. A distinction was made between cases where the cation was a metal and where it was the hydrogen ion. Adsorption and separation methods made possible at high ionic strength were examined. Finally, experiments were reviewed where activated carbon is modified by the adsorption of organic acids and by the incorporation of hydrous oxides.

*Waste water treatment, *Activated carbon, *Adsorption, Anions, Cations, Tracers, Analytical techniques, Laboratory tests

D427
TECHNOLOGY, BILLIONS ADVANCE WASTEWATER EFFORT,

Engineering News Record, Vol. 195, No. 13, p 18-31, October, 1975.

The construction of advanced water treatment (AWT) facilities to combat water pollution is estimated at two billion. The major impediment is cost. The research budget for AWT has been cut back in recent years; EPA's research allocations are mostly spent on already existing plants and processes. The National Commission on Water Quality's final report on costs and benefits will be released in March and is expected to greatly influence the development of the AWT market. In addition, there is hesitation on the part of municipalities and industries. Some feel that secondary projects not yet put into effect should be given precedence over AWT. Some recommend further research before the project is undertaken but caution against too long a delay. Others want to reexamine the need for AWT at all. Moderate views support the installation of AWT plants where secondary treatment is inadequate. The many processes available to remove remaining pollutants of secondary effluents are reviewed. The largest portion of the AWT research budget is devoted to the problem of sludge disposal. More than forty percent of the capital cost of a treatment plant is utilized in sludge handling. While the United States is more advanced than other countries in AWT technology, Israel, Germany and the USSR all have AWT research or plants. AWT activity is growing in Japan, and Sweden is starting a full-size program.

*Waste water treatment, *Tertiary treatment, Treatment facilities, Costs, Government finance, Sludge disposal, Capital costs

D428
REHABILITATION OF A RECREATIONAL LAKE THROUCH AREAWIDE SEWERAGE,

Public Works, Vol. 106, No. 10, p 98-99, October, 1975.

In 1970, a waste water collection system and treatment facilities for sewage from four townships around Lake Koshkonog, Wisconsin, were proposed to replace the existing septic tank systems. The lake shore soil conditions did not favor the continued use of septic tanks, and the construction of areawide sewerage was viewed as a solution to the deterioration of the lake water quality. A sanitary district was organized, and facilities to accomodate 5500 connections were designed. The collection system for the waste water was complicated by having to follow one-third of the lake shore and part of the Rock River, necessitating providing 125,000 linear feet of 8-inch to 24-inch gravity sewers and 25,000 feet of force mains. Treatment for the collected water was provided by the concentration of wastes to a single discharge point. An aerated lagoon system was used, consisting of three lagoons, each with a surface area of 2.3 acres. Their combined capacity was 18 million gallons, at a flow rate of 600,000 gpd. The lagoons operate in series, and retention at the design flow is about 30 days. BOD loading was estimated to be 1020 pounds per day. Monitoring and laboratory testing at the lagoons has been implemented and routine duties include checking blower operation, reading meters, recording pressures and waste water flow and chlorine use, collecting samples and performing laboratory tests for BOD, DO, suspended solids, pH, and chlorine residual. The facility has been in operation since August 1973. While no analytical measurement of the lake and river quality have been made since the sewerage system was installed, improvement has been noticeable in terms of reduced weed growth and odor.

*Sewerage, *Waste water treatment, *Treatment facilities, Lakes, Rivers, Water quality control, Septic tanks, Wisconsin, Sewer systems

Gravity sewers

D429
CURRENT TRENDS IN PACKAGED WASTEWATER TREATMENT FACILITIES, PART II,

Dresnack, R. and Miller, W.

New Jersey Institute of Technology,
Department of Civil and Environmental Engineering.

Water and Sewage Works, Vol. 122, No. 9, p 96-99, September, 1975. 11 fig.

A state-of-the-art review of package waste water treatment is presented, including performance data and a selection guide. Extended aeration activated sludge is described; the main components of an extended aeration plant are the bar screen, comminutor, aeration tank clarifier return sludge pump, aerobic sludge digester, and chlorination facilities. Two types of package aeration plants are illustrated. Such package plants can offer the flexibility of many types of combinations of aeration volumes and clarifier sizes, for more economical installation. A variation, the Oasis Process, uses pure oxygen in place of air to aerate the mixed liquor. Another package process, the Bio-Disc system, has been designed and fabricated in modules for both package and separate component treatment plants. One type of Bio-Disc plant is described, which uses a combination of aerobic and anaerobic treatment processes. Other packaged systems are of the chemical and physico-chemical types. Chemical treatment of waste water requires that chemicals react with each other and with the constituents of waste water to produce a flocculant precipitate and thus will either: increase the sedimentation rate; or release oxidizing ions to oxidize the organic matter; or kill organisms to disinfect the waste water.

*Waste water treatment, *Treatment facilities, *Aeration, Biological treatment, Anaerobic conditions, Aerobic conditions, Economics, Installation, Oxygen, Oxidation, Disinfection

Packaged treatment plants, Chemical treatment, Physico-chemical treatment

D430
TWO CITIES TEST REVERSE OSMOSIS SYSTEM,

The American City and County, Vol. 90, No. 9, p 122, September, 1975.

A pilot project for the removal of salts from treated waste water is being developed by the cities of Escondido and San Diego, California. Secondary sewage effluent (about 150,000 gpd) from the Escondido southside water reclamation facility had been limited in use to pasture irrigation because its dissolved salt content was 1550 ppm. With this system, a reverse osmosis method will reduce the salinity by 95% to approximately 75 ppm. The treated water will be recombined with conventional effluent to produce a mixture suitable for irrigating plants and shrubs with low to moderate salt tolerance. The cities plan to use the water to irrigate a golf course and other areas in the Escondido Kit Carson Park. Other reverse osmosis systems have been successful in California industrial plants. One such example is the Burroughs Corporation in San Diego, which has reduced its water purification costs by 75% with a 50,000 gpd reverse osmosis system.

*Sewage disposal, *Pilot plants, *Reverse osmosis, *California, *Irrigation, Salinity, Water purification, Waste water treatment, Recycling, Water reuse

Salt removal, Waste water reuse

D431
ACTIVATED CARBON: OLD SOLUTION TO OLD PROBLEM, PART II,

Adams, A. D.

Water and Sewage Works, Vol. 122, No. 9, p 78-80, September, 1975. 4 fig, 1 tab, 24 ref.

The use of lignite powdered activated carbons in anaerobic digesters, due to the carbons' properties of density and activity, is proposed. Carbon aids in settling supernatant solids so that fewer fine, poor-settling solids are returned to the hydraulic processing section of the plant. Powdered carbon also adsorbs grease and scum that might clog digesters and interfere with mixing. By adsorption, carbon also removes detergents which could interfere with dewaterability of the digested sludge. While the addition of carbon initially increases operating costs, it settles biological solids, clears supernatants, removes odors, and thickens sludge. Digesters containing activated carbon are less susceptible to upsets than conventional systems, and adsorb inhibitory substances that could be toxic to the anaerobic bacteria. Costs over time are reduced because there is less need for dewatering chemicals, deodorant chemicals, chlorine, and supplementary fuel oil. A graphic representation is provided of the time required for an anaerobic system to respond to activated carbon addition. Within two months, supernatants should clear, as carbon becomes incorporated in the biofloc. By four months, gas production should increase and sludge solids should decline. Within six to eight months, the daily carbon dose will be reduced because less sludge is being withdrawn from the digester and operating costs will be lowered accordingly.

*Activated carbon, *Adsorption, *Water treatment, Anaerobic conditions, Sedimentation, Sludge treatment, Dewatering, Operating costs, Anaerobic digestion

D432
FATE OF NITROGEN IN SEWAGE EFFLUENT APPLIED TO SOIL,

Lance, J. C.

U. S. Department of Agriculture,
Phoenix, Arizona,
Agricultural Research Service.

Journal of the Irrigation and Drainage Division-ASCE, Vol. 101, No. IR3, p 131-144, September, 1975. 2 fig, 1 tab, 33 ref.

The amount of nitrogen removal in the land application of sewage water is dependent upon the selection of the appropriate soil and the management of the system. The three types of land treatment systems are low rate or irrigation systems, high-rate land filtration, and overland flow. With an irrigation system, a crop is grown and harvested, with sewage water application being between four and fifteen feet per year. Most of the nitrogen and nutrient removal is due to plant uptake. In a high-rate system, about 10 to 30 times as much sewage water is applied. Nitrogen is removed by denitrification, whereby nitrogen passes through both an oxidized environment for nitrification and a reduced zone for denitrification within the same soil profile. This is best accomplished by alternating flooding and drying cycles, so that NH-4 is adsorbed by soil cation exchange during a flooding period and held until the dry period when oxygen enters the soil and nitrification may occur. In overland flow systems, using soils of low permeability, water runs off and is collected at the bottom of a slope. The sewage water trickles over grassed land where plant uptake removes some of the nitrogen; nitrogen is also removed by volatilization of ammonia and in part by denitrification. All three land treatment systems are dependent upon site selection according to the local situation.

*Denitrification, *Nitrification, *Sewage disposal, *Waste disposal, Waste water treatment, Filtration, Irrigation, Water reuse, Nutrient removal, Nitrogen, Overland flow

D433
ESTUARY TO BE STUDIED AS D.C. WATER SOURCE,

Jacobson, A. R.

Illinois State University,
Normal,
College of Applied Science and Technology.

Public Works, Vol. 106, No. 10, p 122, October, 1975. 1 fig.

An indirect waste water reuse plan is being considered to supplement the water supply of the metropolitan Washington, D.C. area. An experimental plant is being designed with a capacity of one mgd, to provide facilities and equipment for the study of several types of treatment processes. The experimental plant will test the treatment of water from the Potomac River Estuary, which receives Blue Plains waste water effluents. A central monitoring and control center will be available to sample the processes, which include: pretreatment, such as microscreening; coagulation, flocculation, and sedimentation; rapid sand filtration; activated carbon adsorption; and final treatment via ozonation or chlorination, or by the choice of reverse osmosis, electrodialysis, or ion exchange, followed by disinfection. Estimated design and construction costs are about $6 million and operating costs, including research, are expected to be $1.4 to $1.7 million per year.

*Water reuse, *Waste water treatment, *Treatment facilities, *Pilot plants, Design criteria, Estuaries, Recycling, Operating costs, Capital costs, Research and development

*Waste water reuse

D434
EMERGENCY REPAIR OF CRACKED HOLDING TANK,

Jacobson, A. R.

Illinois State University,
Normal,
College of Applied Science and Technology.

Public Works, Vol. 106, No. 10, p 114, October, 1975.

Emergency measures were undertaken to repair a cracked excess sludge holding tank at a resort area waste water treatment plant at Lake Wallenpaupack, Pennsylvania. The plant was of the extended aeration activated sludge type and had an excess sludge holding tank which is emptied by tank truck periodically. During a routine maintenance check, the tank was found to have cracked at a point about four feet from the top. A concrete material, Exide Mari-Crete, was applied as a repair product and successfully sealed the tank crack without requiring a primer. The material is obtained as a dry product and is mixed with water to a putty-like consistency. Mari-Crete possesses a 24-hour compressive strength of 3100 psi and a 24-hour tensile strength of about 280 psi under humid conditions, and higher under dry conditions. After application of the repair product, a protective coating of asphalt was applied and the tank was returned to operation.

*Waste water treatment, *Activated sludge, *Tanks, Concrete, Repairing, Construction materials, Maintenance

*Mari-Crete, Holding tanks

D435
COMPARATIVE STUDIES ON THE ACTION OF CHLORINE AND OZONE ON POLIO-VIRUSES IN THE REPROCESSING OF DRINKING WATER IN ESSEN (VERGLEICHENDE UNTERSUCHUNGEN UEBER DIE WIRKUNG VON CHLOR UND OZON AUF POLIOVIREN BEI DER TRINKWASSERAUFBEREITUNG DER STADT ESSEN),

Thraenhart, O., and Kuwert, E.

Zentralblatt fuer Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, Abteilung 1: Originale, Reihe B: Hygiene, Praeventive Medizin, Vol. 160, No. 4/5, p 305-341, 1975. 16 fig, 13 tab, 51 ref.

In order to decide whether to change the method of potable water supply treatment from chlorine to ozone in Essen, Germany, the comparative inactivation of polio virus type I strains by means of chlorine and ozone were evaluated under laboratory conditions. Polio virus type I was chosen because of its epidemiological behavior and high stability in drinking water and sewage lines. The virus-inactivating effect of specific quantities of disinfectants in water without redox-potential (double-distilled water), water with low defined redox-potential (double-distilled water + KOH), previously chlorinated water with a residual chlorine content of 0.03 mg chlorine per liter (tap water), and water with a high redox-potential (well water from the drinking water plant) were examined. Time course studies were performed, both with chlorine and ozone, to evaluate the characteristics of the inactivation procedure. Results took into account the quantitative differences in effect, and confirmed that chlorine and ozone can be considered equivalent in their action of virus-disinfection. The initial rate and the kinetics of virus disinfection were identical, and the effectiveness of both disinfectants was dependent upon the condition of the water (such as redox-potential, pH) to a great extent. A decision of whether to use ozone or chlorine to disinfect the drinking water supply in Essen, Germany, could not be drawn on the basis of these virological experiments. That decision must be based on facts such as relative costs and practicability of ozonization on a large technical scale.

*Ozone, *Chlorine, *Water treatment, *Potable water, Water supply, Hydrogen ion concentration, Viruses, Sewage, Disinfection, Waste water treatment, Costs

*Essen (Germany), *Poliovirus, Redox-potential

D436
DDC PROCESS OF SAIKAWA WATER TREATMENT PLANT IN KANAZAWA CITY,

Aoki, H., and Kamei, H.

Suido Kyokai Zasshi, No. 487, p 20-30, 1975. 8 fig.

The DDC system of the Saikawa water purification plant, Japan, is described. The plant has a maximum treatment capacity of 161 cu km/day with one water basin, three rapid agitating basins, six sedimentation basins, nine high speed filtering basins, one chlorine mixing basin and two water purification basins. Chemicals used for water treatment included chlorine as a disinfectant, PAC as an aggregating agent, and sodium alginate as a co-aggregating agent and alkali. An SPC long distance control system is used for monitoring water piping and the water reservoir while the DDC system is used for monitoring the water purification and water distribution basins. The DDC system consists of a central operation-treatment machine, man-machine communication devices, a detection apparatus and an on-spot control board. The system controls the water level, water quantity and quality, application of chemicals and disinfection, and the automatic operation of machinery. Minor loop control of the process for the DDC system is conducted by PID feedback control.

*Water treatment, *Control systems, *Filtration, *Computers, *Sedimentation, Water purification, Chlorine, Monitoring, Treatment facilities

Japan, DDC system

D437
MARSHES AND WETLANDS MAY PROVIDE SAFE COMMUNITY TERTIARY SEWAGE TREATMENT,

Compost Science, Vol. 16, No. 4, p 31, July-August, 1975.

The preliminary conclusion of a University of Michigan research project now in its third year is that marshes, bogs, swamps and other wetlands are able to provide high-quality tertiary sewage treatment. The project was designed to find out whether the natural processes in a 1,000 acre marsh near Houghton Lake in north central lower Michigan will be able to provide tertiary treatment of waste water without disturbing the ecological balance. The research has included a survey of pertinent scientific literature, the construction of a computer model of the marsh, and small, carefully controlled, on-site experiments. The model portrays the dynamic character of the marsh and accurately simulates the complex interactions among soil, water, wildlife, and climate. The model predicts that when millions of gallons of secondarily treated effluent are pumped into the marsh, the four-foot layer of peatland covering the area will absorb many of the dissolved nutrients in the water; only a small portion of the total will be utilized by vegetation. Wetlands bordering lakes and streams must not be used for treatment because of the risk that effluent would reach adjacent waters before being sufficiently purified. Each potential treatment site must be thoroughly studied to ensure that the wetland will be able to remain in an aesthetic and viable state, and the water quality will meet environmental standards.

*Waste water treatment, *Tertiary treatment, *Wetlands, *Marshes, Environmental effects, Biological treatment, Model studies, Waste water disposal, Water quality control

D438
FILTRATION IN TERTIARY TREATMENT FOR SEWAGE WATER
(Gesui no sanjigen shori ni okeru roka),

Matsuura, T.

Mizushori Gijutsu, Vol. 16, No. 6, p 551-558, 1975. 12 fig, 3 tab.

Tertiary treatment of waste water effluent from a secondary treatment facility was studied by a filtration technique using anthracite and sand as the filtration materials. Filtration efficiency was determined by the turbidity ratio between the filtered water and sample water. The efficiency increased with the increased height of the filtration layer, slower filtration speed, and smaller particle sizes of filtration materials. Based on these preliminary data, an experimental plant was constructed, in which a filtration tower 300 cm in height with a 60 cm diameter, and a double layer of anthracite and sand was employed. The particle size of filtration material used was the effective particle diameter of 1.0 to 2.8 mm for anthracite, and 0.4 to 0.9 mm for sand. The experimental plant had the water treatment capacity of 2.8 to 5.6 cu m/hr depending upon the filtration speed (linear velocity 10 to 20 m/hr). Three techniques were used: direct filtration; coagulation filtration with aluminum sulfate; and coagulation/precipitation/filtration with aluminum sulfate in which the sample water was precipitated upon coagulation with alum prior to the filtration. The last filtration method gave the best results in the quality of treated water. By this method, more than 80% of the original turbidity could be removed and the turbidity in the treated water was less than 5. The efficiency of BOD removal was over 70% to ensure the 10 ppm level of BOD in the treated water. The removal of COD and TOC were not as great; however, 30 to 50% efficiency were obtained.

*Tertiary treatment, *Filtration, Turbidity, Biochemical oxygen demand, Waste water treatment, Treatment facilities, Coagulation, Chemical precipitation

Alum, Anthracite, Sand filters

D439
DESIGN SEMINAR FOR LAND TREATMENT OF MUNICIPAL WASTEWATER EFFLUENTS. DESIGN FACTORS PART I,

Pound, C. E., and Crites, R. W.

Metcalf and Eddy, Engineers,
Palo Alto, California.

Technical Report for United States Environmental Protection Agency Technology Transfer Program, August, 1975. 50 p, 2 fig, 12 tab, 37 ref.

As the first of two papers prepared for the Environmental Protection Agency Technology Transfer Program on Land Treatment of Municipal Wastewater Effluents, some of the basic design factors for land application are presented. Objectives of land application processes are discussed, as well as preapplication treatment, land suitability, selection of the land application process distribution techniques, climatic factors, storage, surface runoff control, public health considerations, and monitoring requirements. Because land application systems are site-specific and flexible, there are several alternatives. Three approaches to land treatment were detailed: irrigation, for the growth of plants; infiltration/percolation, a high rate application process; and overland flow, using impermeable soils. The objectives of irrigation are containment of nutrient rates, economic return, and water conservation; objectives of infiltration/percolation are groundwater recharge; and overland flow is used primarily for secondary treatment or advanced waste water treatment. Land requirements for each type of land application include the wetted land area as well as miscellaneous buffer areas. Sites must be evaluated for climate, topography, vegetation, geology, and soils. The suitability of a site depends upon its location, compatibility with overall land use plans, proximity to surface water, and the number and size of land parcels. Monitoring is considered very important for land treatment systems, particular to determine the cation exchange capacity (CEC) of the soil.

*Design criteria, *Waste water disposal, *Municipal wastes, Irrigation, Land use, Runoff, Public health, Soils, Monitoring

*Land treatment, Overland flow, Infiltration/percolation, Land application

D440
DESIGN SEMINAR FOR LAND TREATMENT OF MUNICIPAL WASTEWATER EFFLUENTS. DESIGN FACTORS PART II,

Powell, G. M.

CH2M-Hill,
Denver, Colorado.

Technical Report for United States Environmental Protection Agency Technology Transfer Program, September, 1975. 68 p, 22 fig, 10 tab, 43 ref.

As the second of two papers prepared on design factors for land treatment of municipal waste water effluents, a review of land application processes and factors influencing the identification and selection of land application sites is presented. Effluent loading constraints, effluent loading design and the operation of alternative land application systems are detailed. An emphasis was placed on the design of a suitable loading rate and the requirements for drainage, field investigations, monitoring systems, crop selection, irrigation schedules, and farm management. An example of the selection process was graphically illustrated for Colorado, involving location, land availability and costs, environmental impacts, loading capacity, and water rights. Impacts on groundwater of the high rate irrigation process and for infiltration/percolation were compared. Effluent loading constraints--climatic, infiltration, percolation, nutrient removal, ss, BOD, COD, and inorganics--were discussed. In designing a suitable and flexible loading rate, the goal should be relatively constant movement through soil, avoiding undesired seasonal load. It was recommended that application be increased during the peak of the evapotranspirational period. In systems using an irrigation method for land treatment, the groundwater mound must be taken into account. As this mound builds up over time, the loading rate must be decreased to postpone the need for drainage.

*Waste water disposal, *Municipal wastes, Irrigation, Groundwater, Irrigation, Land use, Design criteria, Environmental effects

D441
SURFACE AERATORS FOR EFFLUENT TREATMENT,

Surveyor, Vol. 146, No. 4344, p 56, September 12, 1975.

Floating Aqua-lator surface aerators have been developed for the treatment of sewage and industrial effluents prior to discharge. These were designed for installation in a lagoon or river, or in a pit or tank at a treatment works. The aerators work most efficiently when distributed at progressively increasing distances so that each aerator receives effluent from the previous one when the dissolved oxygen level drops to about one mg/liter. Two basic types of Aqua-lator aerators are series FLTM, with ratings of up to 20 hp, comprising a glassfiber floating unit supporting an axial pump; and series 400, covering ratings of up to 75 hp. These models are based on the same principle but the series 400 models were designed to follow special hydraulic optimization. Both types of Aqua-lator aerators can be equipped with anti-swirling devices. Other options include a draft tube for deep tank operation and an anti-erosion device for very shallow lagoons.

*Aeration, *Sewage treatment, *Waste water treatment, Installation, Treatment facilities, Effluents, Dissolved oxygen, Models, Lagoons

*Aqua-lator surface aerators

D442
BEST ALTERNATIVE TO OCEAN DISPOSAL,

The American City and County, Vol. 90, No. 9, p 44, September, 1975.

Recommendations from the Phase 1 Technical Report that led to the development of the New York-New Jersey Metropolitan Area Sewage Sludge Disposal Management Program are reported. While a limited quantity of sludge may be disposed of by land application, the best alternative to land or ocean sludge disposal is dewatering by filter presses followed by pyrolysis. The choice of best disposal method was based on environmental impact, economic feasibility, and energy recovery. It was suggested that ocean disposal, which is used extensively in the New York-New Jersey area, should be phased out and that multiple hearth incinerators which could be converted to pyrolysis units should be implemented. Due to potential air pollution, finding sites for incineration might be difficult. The total costs of facilities to handle 2000 tons of sludge by the year 200 has been estimated at $400 to $500 million in current dollars.

*Dewatering, *Incineration, *Waste water disposal, *Sludge disposal, Environmental effects, Costs, Treatment facilities

Pyrolysis, Filter presses

D443
MUNICIPAL WASTEWATER REUSE IN THE U.S.,

Schmidt, C. J., Kugelman, I., and Clements III, F. V.

SCS Engineers,
Long Beach, California.

Journal Water Pollution Control Federation, Vol. 47, No. 9, p 2229-2245, September, 1975. 18 tab, 2 ref.

A state-of-the-art survey was compiled on existing municipal waste water reuse systems. The examples provided emphasize direct reuse of the water as it leaves the treatment plant. Data were organized into the categories of: irrigation and other agricultural uses, cooling water, industrial process water, boiler feed water, recreational lakes, fish propagation, and nonpotable domestic use. Operations for 358 sites in the United States were studied. Of these locations, about 95% were in the semi-arid southwest states of Texas, California, Arizona, New Mexico, Colorado, and Nevada. Total reuse volume was 133 bil gal, exclusive of groundwater recharge. About one quarter of the plants furnishing waste water for irrigation in 1972 provided only primary treatment. While many irrigation systems were intended as disposal methods, there has been increased concern that pollution and infiltration may have an adverse effect on groundwater resources. Only 14 industrial plants now use municipal waste water, and potential industrial reuse opportunities have not been recognized. Treated municipal waste water has been used for cooling water makeup at 12 facilities. This is probably the most underdeveloped reuse potential of such waste waters. Three California municipal treatment plants now provide treated effluent for major lake recreational projects; these are successfully providing high quality effluent, and pose no health hazards. Overall, only a small percentage of municipal waste water is reused in this country, and continued development of reclamation programs is recommended.

*Water reuse, *Municipal wastes, *Recycling, Irrigation, Groundwater, Water pollution control, Groundwater resources, Municipal water, Waste water treatment, Lakes, Cooling water

*Waste water reuse, Industrial reuse

D444
WASTE WATER AERATION WITH OXYGEN (ABWASSERBELUEFTUNG MIT SAUERSTOFF),

Karnovsky, F.

Abwassertechnik, Vol. 26, No. 3, p 18-20, 1975. 6 fig.

Methods and equipment for the aeration of waste water with technical-grade oxygen rather than with air, as developed by Union Carbide, Airco, Ames Crosta, and Linde AG, are described. The UNOX system developed by Union Carbide uses series-connected closed aerator tanks into which oxygen is admitted through perforated pipes. The Airco System uses tubular reactor for the oxygenation of waste water mixed with oxygen-enriched activated sludge and return sludge. A combination of a first biological stage with oxygen and a second flotation stage using air was used experimentally in France. Compared with conventional aeration, oxygenation offers an increased oxygen content in the waste water, increased sludge concentration, and consequently an increased purification efficiency at a slightly increased operating cost.

*Waste water treatment, *Aeration, *Oxygen, Sludge treatment, Biological treatment, Oxygenation

UNOX process

D445
FLOW EQUALIZATION--PLUS FOR WASTEWATER TREATMENT PLANTS?,

Civil Engineering--ASCE, Vol. 45, No. 9, p 66-68, September, 1975. 2 fig, 1 tab.

Flow equalization for waste water treatment processes is discussed, particularly the achievement of equalization by building retention basins at the treatment site. Advantages of a "steady-state" waste water treatment process are the potential for better biological and chemical actions, resulting in improved effluent; design economies with the elimination of peak flows; power savings; and operation reliability. Two EPA projects in Michigan were investigated in detail. One at Ypsilanti uses an in-line retention basin where all flow is passed through the basin and the other, at Walled Lake, uses a side-line basin where only excess flows are diverted. One reason that more plants have not used retention basins is that traditional plant design includes oversize clarifiers. Because of EPA effluent standards, plants must now be designed for peak flows. Proponents of flow equalization believe that design should return to average flow criteria. The cost effectiveness advantage of flow equalization rather than overdesigning has not been resolved. Besides regulatory agency restrictions, cost decisions on flow equalization will depend upon individual factors for a given plant, such as size of facility, flow variations, quality of influent, desired quality of effluent, and site considerations.

*Flow rates, *Waste water treatment, *Treatment facilities, Retention, Effluents, Design criteria, Economics

*Flow equalization, *Retention basins, Peak flows

D446
DIFFERENT AERATION SYSTEMS FOR GROUNDWATER AND SURFACE WATER (VERSCHIEDENE SYSTEME ZUR BELUEFTUNG VON GRUNDUND OBERFLAECHENWASSER),

Moergeli, B., and Ginocchi, J.

Chemie-Technik, Vol. 4, No. 5, p 175-178, 1975. 9 fig, 13 ref.

Different types of aerations systems for groundwater and surface water are described and compared. Open aeration systems such as atomizers, ring aerators, and corrugated foil type aerators have diffusion coefficients of 150/hr, 50/hr, and 170/hr, as well as surface loads of 250 cu m/sq m per hr to 800 cu m/sq m per hr, respectively. Closed aerating systems are bubbling aerators or surface aerators, such as roller and gyro type aerators, or aerators with submerged pumps. Surface aerators are used when the water to be aerated has sufficient flow speed. The closed type Sulzer aerator, consisting of a cylinder providing for intense mixing of the two phases and for continuous renewal of the phase boundary, proved to be most efficient of all aerators investigated. It adopts the static system and parallel flow of water and compressed air. It ensures a diffusion coefficient of 170/hr and surface loads of up to 1000 cu m/sq m per hr.

*Groundwater, *Surface waters, *Aeration, *Water treatment, *Waste water treatment, Biological treatment, Equipment

Aerators

D447
STORM RUNOFF PURIFICATION IN COMBINED SEWER SYSTEMS IN TOWNS OF THE USA (Ochistka livnevykh vod v sisteme obshchesplavnoy kanalizatsii gorodov SShA),

Lukinykh, N. A.

Vodosnabzhenie i Sanitarnaya Tekhnika, No. 7, p 32-43, 1975. 3 fig, 3 tab.

Storm runoff purification in demonstration waste water treatment plants in Kenosha and Racine, USA are described. The Kenosha demonstration plant was dimensioned for an additional storm runoff of 78,500 cu m/day in rainy weather. The storm runoff is purified by a contact biosorption method using regenerated activated sludge of the principal waste water treatment plant in a quantity of 13,950 cu m at a contact time of 15 min. After the short-term contact and aeration, the storm runoff is sent to a radial settler from which the purified water is discharged into Lake Michigan; the activated sludge is sent to an aerobic stabilizing basin. The settling basin and the stabilizing basin are used for the stabilization of the excess activated sludge during dry weather, and for sludge storage during rainy weather. The storm runoff collected in the combined sewer system in Racine undergoes physico-chemical treatment by microfiltration and flotation tanks. Here, the storm runoff is treated with iron chloride (20-25 mg/liter) before microfiltration, and with cationic polyelectrolyte (1-4 mg/liter) after microfiltration. The water is disinfected with liquid chlorine at an expenditure of up to 20 mg/liter. One fourth of the water discharged from the microfilter is aerated to intensify the subsequent flotation process. The flotation residue is sent to the municipal biological waste water treatment plant.

*Storm runoff, *Combined sewers, *Treatment facilities, Biological treatment, Activated sludge, Aerobic conditions, Filtration, Lake Michigan, Waste water treatment

Microfiltration, Biosorption, Physico-chemical treatment

D448
ENERGY DISSIPATOR AIDS FIGHT AGAINST HIGH PRESSURE PROBLEMS,

Water and Sewage Works, Vol. 5, No. 2, p 76-77, September, 1975. 2 fig.

Because of environmental considerations it became necessary for wells in California's San Bernardino mountain region to be closed and for water to be drawn for this region from the Feather River aqueduct that traverses the coastal mountain chain. Because of pressures as high as 172 ft/sec, severe cavitation problems were involved in transporting the aqueduct water. An energy dissipator was developed to deal with these problems, comprising tubes of varying length filled with furnace welded steel balls and placed inside a water main. Cavitation was able to occur within the dissipator and blockage was efficiently cleared out from it with no damage to the unit. The water agency which services the San Bernardino mountain area has equipped each of its 27 turnouts with an energy dissipator. This increased its water costs; it must charge $250/acre ft, as compared to $70/acre foot charged by valley agencies. However, because environmental considerations are so compelling, and because of health department actions against wells, about 6% more customers per year are using the water from the Feather River Aqueduct. The new energy dissipator permits this water to be distributed safely and efficiently.

*Energy dissipation, *Water pressure, *Cavitation, *Equipment, Water rates, Water supply, Costs, Aqueducts, Wells, Environmental effects

*Energy dissipator

D449
USE OF REVERSE OSMOSIS AND ULTRAFILTRATION FOR REMOVING MICROORGANISMS FROM WATER,

Hinterberger, J. A., Lindsten, D. S., and Ford, A.

U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Virginia, Sanitary Sciences Division, Military Technology Department (STSFB-MS).

Report No. 2111, September, 1974. 81 p, 32 fig, 18 tab, 11 ref.

An investigation of the efficiency of reverse osmosis (RO) and ultrafiltration to remove bacteria from water in order to produce safe potable water was conducted. Raw polluted Potomac River water and Fort Belvoir, Virginia, tap water enriched with test organisms were used as the test water. Reverse osmosis and ultrafiltration membranes are very effective in removing bacteria from water. RO membranes in full-scale pilot plants initially had a nearly 100% rejection rate which decreased depending on feedwater quality, operating time, and length of shutdown period. Commercial RO membranes are not perfect, and bacteria can pass through the leaks. The difference in rejection rates of microorganisms between laboratory equipment using membrane disks, and rejection rates of full-scale pilot plant is due to the large difference in membrane area which has a greater risk of leaks. Chlorination of the feedwater so that there is a free chlorine residual in the product water is recommended to counteract or minimize the biological degradation of the cellulose acetate membrane and to suppress bacterial growth on the membrane surface. It is necessary to also post chlorinate the product water. An enrichment of bacteria in technical equipment resulted from long interruptions overnight or on weekends. A combined water purification system of RO and ultrafiltration will achieve an excellent potable water quality. However, the enrichment effect causes breakthrough of microorganisms. In order to make this treatment safe, it is necessary to prevent enrichment.

*Water treatment, *Potable water, *Reverse osmosis, Membrane processes, Membranes, Pilot plants, Bacteria

Ultrafiltration

D450
REVERSE OSMOSIS OF TREATED AND UNTREATED SECONDARY SEWAGE EFFLUENT,

Boen, D. F., and Johannsen, G. L.

Eastern Municipal Water District, Hemet, California.

EPA-670/2-74-077, September, 1974. 217 p, 36 fig, 96 tab, 7 ref, 6 append.

A pilot plant study was conducted using six commercially designed reverse osmosis (RO) pilot units to determine the feasibility of treating secondary effluent by reverse osmosis in order that the final effluent could be used as an integral part of the Hemet-San Jacinto (California) groundwater recycling program. The use of RO in the groundwater recycling program is relatively expensive in comparison with importing Northern California water. The effective post secondary treatment sequences include: alum clarification followed by sand filtration; sand filtration followed by granular activated carbon treatment; and, alum clarification followed by granular activated carbon treatment. Post secondary effluent treatment significantly reduces the cost of RO, and also lengthens the useful membrane life. The most effective membrane rejuvenation techniques are enzymatic detergent solutions, and a solution of EDTA acid. The use of higher Reynolds number flow conditions effectively retards membrane fouling. The spiral wound configuration and one of the tubular modules exhibited the best overall performance. Costs of reverse osmosis treatment are discussed, and comparisons are made between the different RO modules tested.

*Waste water treatment, *Reverse osmosis, *Sewage treatment, Membrane processes, Membranes, Equipment, Costs, Water reuse, Groundwater, Recharge

Post secondary sewage treatment

D451
LAND SPREADING OF INDUSTRIAL WASTE WATER AND THE EFFLUENT FROM A SECONDARY TREATMENT FACILITY,

Ward, W. E., and Gray, D. V.

General Electric Company, St. Petersburg, Florida,
Neutron Devices Department.

Report No. GEPP-127, November, 1974. 6 p, 2 fig, 1 tab.

The Pinellas Plant of the General Electric Company, located in west central Florida, treats its industri l and sanitary wastes by land spreading, coupled with a subsurface drainage system. Industrial wastes are discharged to a neutralization facility where the acidic pH is adjusted. Approximately 42,000 gpd are then discharged into the west retention lake. Sanitary wastes are pumped to a 20,000 gpd activated sludge sewage treatment plant. The plant removes 97% of the BOD and suspended solids, but does not remove nitrogen and phosphorus. After chlorination, the sewage is also released to the west retention lake. The combined wastes are retained in the west retention lake for an average of 40 days while being continuously aerated. Water from the west lake is spray applied to the irrigation field. Four-inch perforated polyethylene pipes surrounded by gravel form the underground drainage system. Water collected in the drain sump is directed to the east lake. Discharges from this lake are controlled by a Parshall flume equipped with a recorder and a continuous flow integrator connected to an automatic proportional sampler. The system achieves a 69% reduction in total nitrogen, a 72% reduction in BOD, and a 87% reduction in phosphates. The capital cost of the land spreading system was about $40,000. Operating costs for 1973 were $750 for treating 20 million gallons of effluent.

*Waste water treatment, *Industrial wastes, *Municipal wastes, Irrigation, Biological treatment, Nutrient removal, Phosphates, Nitrogen, Biochemical oxygen demand, Waste water disposal, Capital costs, Operating costs

Land application

D452
POLYELECTROLYTES IN PRESSURE FILTRATION: EXPERIENCES AT FARNHAM,

Charlesworth, B. R., Knott, R. A., and Fox, R. A.

Effluent and Water Treatment Journal, Vol. 15, No. 8, p 411-412, 414-415, 417, August, 1975. 2 fig, 2 tab.

The use of polyelectrolytes in the pressure filtration of sludge has the following advantages: low capital costs of conditioning systems; possibility of reduced treatment costs in comparison with traditional chemicals; potential of increased filter press capacity and shorter pressing times; ease of product preparation and application; and, elimination of equipment scaling and corrosion. The use of polyelectrolytes in pressure filtration at the Farnham Water Pollution Control Works (Great Britain) is discussed. The Farnham plant was originally designed for operation with aluminium chlorohydrate as the chemical conditioning agent. However, the larger than design quantity of reagent necessary, the severe water/sludge separation, and heavy filter blinding made this chemical unacceptable. Tests were performed on a range of polyelectrolytes. Capillary suction time (CST) measurements indicated that Zetag 63 was the most promising conditioning agent. Full-scale tests confirmed the ability of Zetag 63 to satisfactorily condition the sludge for filter pressing. The polyelectrolyte was then put into full-plant operation. Performance with Zetag 63 as an on-line rather than batch conditioning system was an efficient system. Tests run with aluminium chlorohydrate as an on-line system, and with ferric chloride and lime as batch systems confirmed that Zetag 63 is a more satisfactory conditioning agent. Between 2 and 3 kg of Zetag 63/ton of dry solids are used at Farnham; the chemical costs are much less than they would be for Al_2O_3, $FeCl_3$, or lime.

*Waste water treatment, *Sewage treatment, *Sludge treatment, Polyelectrolytes, Costs, Filtration

Filter pressing, Chemical conditioning agents, Polyelectrolyte conditioning agents

D453
WIDE RANGE OF EQUIPMENT FOR SEWAGE DISPOSAL,

Water Services, Vol. 79, No. 954, p 335-336, August, 1975.

Adams-Hydraulics Limited of York (Great Britain) has been manufacturing pumps and valves for sewage disposal, water pollution control, and industrial processing since 1885. The Amphistoma centrifugal sewage pump is available in a wide range of capacities up to 250 liters/sec and for maximum head limits of about 35 meters. The principal types are the vertical dry well type and horizontal patterns including portables. Compressed air actuated sewage or sludge ejector pumping units are also available. The ejector can be installed in a below ground level chamber while the compressor is placed in a nearby building since the only connection between the compressor and ejector is a small bore steel air pressure pipe. The company will supply the pumps only or will complete the total installation including all the pipework with sluice and reflux valves, all electrical equipment, erection, wiring and painting. Many designs of valves are offered by the firm including: flap valves for river and sea outlets; penstock valves for water and sewage from 80 mm up to 1800 mm diameter; a range of floating arm draw-offs; decanting valves and search arms; sludge plug valves; and relief valves. The Module valve unit is an automatic device used to limit maximum discharge especially from storm water, trade wastes, and water run-off from motorways. Appointments may be made to see the firm's wide range of products being manufactured at York.

*Waste water treatment, *Sewerage, *Equipment, *Pumps, *Valves, Centrifugal pumps, Hydraulic equipment, Hydraulic valves, Flow control, Penstocks

Adams-Hydraulics Limited, York, Great Britain

D454
THE USE OF HIGH-PURITY OXYGEN IN SEWAGE TREATMENT,

Lewandowski, T. P.

Effluent and Water Treatment Journal, Vol. 15, No. 8, p 401-405, August, 1975. 4 fig, 3 ref.

A report was made on the successful use of oxygen in the activated sludge process. Advantages of the use of high purity oxygen are a reduction in land requirements, reduction in power requirements, and an increased ease of operation due to a highly flocculant and thicker sludge. The Union Carbide Corporation had developed a commercial viable oxygen system known as Unox. The Unox system is composed of an aeration tank and an on-site oxygen generator. Because it achieves MLSS concentrations higher than those of conventional systems, Unox allows for reduced tank volumes and commensurate savings in cost. It generates oxygen by cryogenic distillation of liquid air, which is most economical for larger plants, or by the new process of ambient-temperature separation which uses molecular sieves. The Unox system allows for operation at higher organic loadings than normally expected: high quality effluents are achieved at 0.5-0.7 kg BOD/d kg MLVSS, and it has consistently shown a reduction in the amount of surplus sludge produced. This reduction is due both to higher concentrations of MLSS which increase the effect of endogenous respiration, and to a more complete oxidation because of the high DO concentration which maintains high activity in the reactor. The Unox method of process control keeps power consumption to a minimum, based on the enclosure of the reaction tank in a gas-tight cover. Due to this arrangement, the horse power needed to generate oxygen is directly related to the load.

*Equipment, *Sewage treatment, *Activated sludge, *Oxidation, *Sludge treatment, *Oxygen, Organic loading, Biochemical oxygen demand, Dissolved oxygen, Waste water treatment

*UNOX System, Energy use

D455
KILN DUST FROM CEMENT FACTORIES FOR VACUUM FILTER PROCESSING OF SEWAGE SLUDGE,

Baker, D. E., Welch, S., Stout, W., and Doty, W.

Pennsylvania State University, University Park,
Department of Soil Chemistry.

Compost Science, Vol. 16, No. 4, p 28-30, July/August, 1975. 2 tab, 3 ref.

A comparison was made between the use of kiln dust from cement factories and hydrated lime in the vacuum filter processing of sewage sludge within an operational sewage treatment plant. The conventional vacuum filter process of sludge uses hydrated lime and ferric chloride as flocculants. In this experiment, the coil filter was operated one day using the hydrated lime and the next day using kiln dust. Results were analyzed in terms of pH, dry matter, and chemical composition of raw sewage sludge; lime suspension produced from hydrated lime and kiln dust; filter cake produced by the vacuum filter process; and filtrate removed from the sludge in the process. It was found that kiln dust was equal to hydrated lime for processing the sludge and could be superior if used at a rate 1.3 times that normally used for lime. Because there is additional potassium and magnesium in the kiln dust, there is an advantage in its use where the filter cake and/or filtrate effluent are to be used as sources of nutrients for crop production. Economic advantages as well as energy conservation results from the use of kiln dust as a substitute for hydrated lime.

*Sludge treatment, *Waste disposal, Filtration, Sewage sludge, Lime, Flocculation, Analytical techniques, Economics, Energy, Sewage treatment, Waste water treatment, Treatment facilities

*Vacuum filters, *Cement factory kiln dust

D456
ON THE OZONE TREATMENT AS PRE-TREATMENT OF ACTIVATED SLUDGE
(Kassei oden shori no maeshori to shiteno ozon shori),

Aida, K., Somiya, I., and Kawara, O.,

Preprint, Japan Society of Civil Engineers, Tokyo, p 667-668, October, 1975. 5 fig.

Ozone treatment of sewage was investigated as a pre-treatment for the activated sludge method. Sewage was taken from the final precipitation pool of a sewage treatment plant in Kyoto, Japan, and its COD components were 184 mg/liter for the 3.8 to 0.45 micron size, and 57.1 mg/liter for the less than 0.45 micron size. A sample of 1.2 liters of liquid was treated in a batch type aeration tower with an ozonide oxygen flow rate of 2.0 liters/min. The ratio of COD values in the treated water and the initial water was then determined. Ozone concentration did not seem to have much affect upon the COD removal efficiency. COD removal proceeded quickly during the first five minutes of ozone treatment. The ratio obtained for total COD removal was 0.5 after the five minute ozone treatment. Eighty percent of the initial COD components sized greater than 0.45 microns could be removed in five minutes ozone treatment. During the ozone treatment, the BOD5 value did not increase, but the ratio between BOD5 and COD values increased. This suggests that the use of ozone as a pre-treatment method for activated sludge would increase the effectiveness of the biological decomposition process in the waste water.

*Ozone, *Sewage treatment, *Chemical precipitation, Chemical oxygen demand, Biochemical oxygen demand, Pre-treatment, Activated sludge, Biological treatment, Waste water treatment

D457
ON THE NITROGEN BEHAVIOR IN THE PROCESS OF OZONE TREATMENT
(Ozon shori ni okeru chisso no kyodo ni tsuite),

Aida, K., Soniya, I., and Yamada, H.

Preprint, Japan Society of Civil Engineers, Tokyo, p 524-525, October, 1975.
25 fig.

The transformation of nitrogen compounds of amino acids and protein in sewage upon ozone treatment was studied using glycine, glutamic acid, and albumin in cow serum. The concentrations of nitrate ion, ammonium ion, amino acid, and protein in solution were compared to the ozone treatment time, and the effect of the initial solution pH on these nitrogen transformations was also studied. In the case of glycine, the initial concentration was adjusted so that the initial nitrogen in the solution was 9.3 mg/liter; the solution was then treated with ozone. After 40 minutes of ozone treatment, the nitrogen composition in the treated solution was 50% nitrate, 45% ammonium, and 5% amino acid. These changes were not greatly affected by the initial solution pH, and the nitrate and ammonium productions were increased with an increase in ozone treatment time. The nitrogen transformation for glutamic acid was similar to the result obtained with glycine, and was unaffected by the solution pH. The albumin could be ozonized from a solution with a pH between 6.39 and 9.82; however, the amount of unrecovered nitrogen increased with the increased ozone treatment time. The recovery of the initial nitrogen (6.5 mg/liter) after 40 minutes of ozone treatment was 1.8 mg/liter and 50% of this was ammonium with the rest being protein. Nitrate was produced during the ozone treatment of albumin, but could not be detected after 40 minutes of treatment.

*Nitrogen, *Ozone, *Sewage treatment, *Waste water treatment, Proteins, Nitrates, Amino acids, Hydrogen ion concentration, Ammonium compounds, Recycling

D458
PERMUTIT SA ENTERS SEWAGE TREATMENT FIELD,

South African Chemical Processing, Vol. 10, No. 4, p 27, June/July, 1975. 1 fig.

The Permutit company, South Africa, has expanded its primarily industrial waste water treatment activities to include sewage treatment. Initially, pre-engineered units will be used to treat up to 15,000 population equivalents. Either the Extended Aeration (EA) or the Contact Stabilization (CS) process will be used. The design criteria for sewage treatment facilities were sewage flow, composition (particularly BOD loading) and turn down ratio required. The EA process was found to be economical for small plants, while the CS scheme has advantages for larger size plants. The Contact Stabilization process was detailed. It consists of two aeration steps, separated by a settlement stage. In the first aeration stage raw sewage and stabilized activated sludge are mixed and aerated. After 0.25 to 1.50 hours, sludge and liquor are separated, and sludge is returned to a second aeration step for 1.5 to 5.0 hours. Because the total aeration time for EA is about 24 hours, the CS process has the time advantage. The CS process achieves a high degree of nitrification in spite of this short aeration time and has much better sludge settlement rates. The reason for this is that there are about four times the bacteria in the contact aeration zone than in other treatment processes. As a result, to up-rate a conventional plant to a CS plant, the only necessary change was found to be the extension of the settling tank area.

*Sewage treatment, *Treatment facilities, *Biological treatment, *Aeration, *Sludge treatment, Nitrification, Sedimentation, Waste water treatment, Settling basins

*Contact Stabilization (CS), *Extended Aeration

D459
GET THE WATER OUT OF ALUM SLUDGE,

Foster, W. S.

The American City and County, Vol. 90, No. 9, p 83-85, September, 1975. 3 fig.

A description was made of Atlanta's new Hemphill Settled Solids Treatment Plant. It represents a new aspect of water treatment necessitated by stricter standards of stream purity. Its processes apply to any system drawing from surface sources and treating the water by coagulation and filtration. This plant uses three clarifier-thickeners designed for a surface overflow rate of 1.75 gpsf/min, although experience indicates that a lower rate is more effective. In chemical feed tanks the sludge pH is raised to permit dewatering which occurs in pressure filters. These utilize diatomaceous earth and produce a cake of 46% solids, which is transported to a landfill area, and a filtrate of less than 10 ppm suspended solids, which is run through a chlorine contact chamber and returned to the plant's raw water reservoirs. Innovative features include sludge transport through pneumatic ejectors, important because the sludge this plant treats is abrasive and damages equipment with any moving parts. This transport system can move sludge of varying consistencies and eliminates spillage. Operating costs may be as much as $30.86/ton solids removed. The EPA contributed 33% of construction costs. For each filter run, 62,000 gallons of water are returned to the plant's reservoirs. A use is being sought for the dewatered sludge.

*Water treatment, *Sludge treatment, *Dewatering, Coagulation, Filtration, Chlorination, Surface water, Diatomaceous earth, Construction costs, Operating costs, Treatment facilities

*Pneumatic ejectors, *Alum sludge

D460
PLASTIC PUMP HANDLES ACID USED IN WATER SYSTEM,

Water and Sewage Works, Vol. 122, No. 9, p 106, September, 1975.

The world's second largest electrodialysis water treatment system for the island of Siesta Key, west of Sarasota, Florida, is described. Its special feature is a single, all-plastic centrifugal pump, which handles the hydrochloric acid, caustic soda, and other chemicals needed in the system. The electrodialysis process involves the flushing of impure well water through stacks made up of nearly 24,000 membranes charged with either negative or positive ions. During treatment, slime or sludge builds up in the membranes, and is removed by introducing acids into the water and mixing the solution. By using the Chem-Gard heavy duty plastic horizontal centrifugal pump for mixing, both the time needed to flush the membranes and the costs of maintenance are reduced. The pump was installed at a central location, and handles over 250 gal per minute. Pipes run to the membranes, and a series of valves permits the pump to mix solutions at any of the membranes by the opening or closing of selected valves. The pump unit isolates all metal components (including the stainless steel shaft) from contact with the acid fluid being handled. The centrifugal pump has been operating for over a year, in continual on/off operation and has had no failures or parts replacement. Because the pump is mounted in a stationary position on a pedestal, the flushing time has been reduced, and no water treatment stoppages due to pump failure have been reported.

*Water treatment, *Pumps, *Centrifugal pumps, *Plastics, Acids, Electrodialysis, Membrane processes, Maintenance costs, Installation, Treatment facilities, Florida

D461
SUPERNATANT AND FILTRATE TREATMENT,

Sampayo, F. F.

Jones and Henry Engineers, Limited,
Toledo, Ohio.

Pollution Engineering, Vol. 7, No. 9, p 36-38, September, 1975. 1 fig, 1 tab.

Production of high quality effluents, such as those planned for an improved waste water treatment plant in Pontiac, Michigan, will necessitate reconsideration of conventional processing methods for anaerobic digester supernatant and vacuum filter filtrate. These wastes shock load biological treatment processes by increasing BOD, suspended solids, and ammonia concentrations. A new process suggested for the Pontiac plant mixes the two waste streams, discharging them by gravity and heating them with available hot water from the incinerator exhaust gas scrubbing system. The pH is adjusted to 11 or 12 with lime and the high pH wastes are discharged to an ammonia stripping tank. This process is expected to reduce ammonia-nitrate concentrations in the recycle streams to 100 mg/liter or less, as well as removing substantial amounts of BOD and suspended solids. Ammonia discharge to the atmosphere will also be largely avoided. This process uses both chemicals and power with efficiency.

*Waste water treatment, *Biological treatment, *Effluents, Ammonia, Nitrification, Hydrogen ion concentration, Lime, Biochemical oxygen demand, Anaerobic digestion, Filtration, Filters, Suspended solids

*Anaerobic digester supernatant, *Vacuum filter filtrate

D462
HYDROGEN PEROXIDE SOLVES HYDROGEN SULFIDE PROBLEM,

Lindstrom, S. R.

Hampton Roads Sanitation District,
Norfolk, Virginia.

Pollution Engineering, Vol. 7, No. 10, p 40-41, October, 1975. 1 fig, 1 tab.

The Hampton Roads Sanitation District, Virginia, has found that hydrogen peroxide application was successful in eliminating noxious odors caused by hydrogen sulfide in a waste water treatment plant. Tests were conducted in two systems: the Chesapeake-Elizabeth System in Virginia Beach and the James River System in Newport News. Both systems were large, and sewage is pumped long distances through pressure lines for treatment. Anaerobic conditions result from a long sewage retention time, and high (7 to 8 ppm) levels of hydrogen sulfide are formed. Additionally, the buildup of H_2S in working areas is a danger, and complaints of odors have been made by residents and people travelling on adjacent highways. Tests with hydrogen peroxide were initiated in April 1973 and a year later, as a result of successful odor removal, the two hydrogen peroxide injection systems were installed. Injection points were far enough upstream that hydrogen peroxide had at least ten minutes to react with the H_2S before the sewage came out into the air at the head of the plant. At first a ratio of 2.5:1 was thought necessary (H_2O_2:H_2S) to assure oxidation of all the hydrogen sulfide. At the James River system this was followed, with an injection ratio of 17.5 ppm. The Chesapeake-Elizabeth system experimented and found that 15.3 ppm would also effectively destroy all the hydrogen sulfide, with a lower cost. Installation involved a simple passivated aluminum storage tank, two variable speed pumps, and necessary piping; there were no real maintenance costs. Thus, the only expense was the cost of hydrogen peroxide. The daily cost at both plants was $1,325, higher than costs of chlorine, but without chlorine handling or residual hazards.

*Odor, *Hydrogen sulfide, Waste water treatment, Sewage treatment, Virginia, Anaerobic conditions, Treatment facilities, Environmental effects, Costs, Oxidation

D463
HYGIENIC ASSESSMENT OF THE EXISTING TECHNOLOGY OF DRINKING WATER TREATMENT AND CERTAIN MEANS OF ITS IMPROVEMENT (Gigienicheskaya otsenka sushchestvuyushchey tekhnologii ochistki pit'evoy vody i nekotorye puti ee uluchsheniya),

Nikolaeva, T. A., and Pletnikova, I. P.

Gigiena i Sanitariya, No. 7, p 29-33, 1975. 1 tab.

Experimental and field investigations have been performed to determine the barrier role of water works. The capacity of water treatment facilities for removing chemical contaminants is very limited. No effective means for improving the existing methods of water treatment can be suggested at this time. Ozone treatment of potable water is not a universal means of removing chemical pollutants. The most effective and promising technique is activated carbon adsorption.

*Water treatment, *Water works, *Treatment facilities, Potable water, Pollutants, Ozone, Activated carbon

D464
OXYGENATION AND WASTEWATER TREATMENT,

Environmental Science and Technology, Vol. 9, No. 10, p 910-915, October, 1975. 5 fig.

A report was made on the widespread use of oxygenation in the activated sludge process and on the four companies which produce oxygenation systems. The oxygenation process allows space savings of one third and increases gaseous solubility about 5 times. It is now used mainly for the treatment of municipal waste waters, but future applications to combined municipal and industrial waste waters and to industrial waste waters with high BOD values are planned. Union Carbide's closed UNOX system was the first developed, and it has about 90% of the oxygenation market in America. There are also UNOX operations in Japan, Europe and the United Kingdom. Air Product's OASES is a gas-tight closed reactor and was the first on-stream oxygenation system. Air Products is the chief advocate of cryogenic plants as an oxygen supply system, because of their efficient use of energy. Air Products is preparing to enter the international market. Airco's F30 process uses an open tank and the forced free fall of oxygen. Its units are completely automatic. One is in use at a municipal site and one at an industrial operation. Four MAROX plants, produced by the FMC Corporation, are under construction. The MAROX system uses a Rotating Active Diffuser (RAD). The major benefit of the MAROX system is its operation in open tanks which eliminates costly covers and baffles and entrapment of potentially hazardous gases. Another major benefit is the ability to install a MAROX system in existing basins with virtually no tank modifications.

*Activated sludge, *Oxygenation, *Municipal wastes, Industrial wastes, Cryogens, Tanks, Waste water treatment, Biological treatment

*UNOX, *OASES, *F30, *MAROX, Rotating active diffuser (RAD)

D465
CIRCULAR TANK SCRAPER,

Effluent and Water Treatment Journal, Vol. 15, No. 8, p 431, August, 1975. 1 fig.

Scanwater Equipment Limited now produces a new scraper for circular and secondary tanks, known as the Scanscraper. The Scanscraper unit has many adaptable features which suit it to any application. These include: scum blade supports which may be adjusted to allow for the prevailing winds; the scum box which can be sized to specifically suit the tank's diameter; the diffuser drum sized to suit tank dimensions and adjustable for height; and, fully adjustable weir plates. The scanscraper's bridge is offered in aluminum or steel, and tests revealed that it adheres more strongly to the tank wall as prevailing winds increase in intensity. The Scanscraper carries a guarantee of after sales service performed by qualified engineers.

*Equipment, *Sludge disposal, *Engineering, Tanks, Wind velocity, Scum, Maintenance

*Scanwater Equipment Limited, *Scanscraper

D466
WASTE WATER TREATMENT WITH AN SO3 REMOVAL BY-PRODUCT,

Lin, P-W.

Journal Water Pollution Control Federation, Vol. 47, No. 9, p 2271-2280, September, 1975. 11 fig, 5 tab, 14 ref.

Methods for using the by-product of an atmospheric pollution control process in waste water treatment are described. Laboratory produced by-product has been demonstrated to be suitable for waste water treatment by acid neutralization, as a binder for flyash to produce construction materials, and for phosphate and turbidity removal. The by-product contains unspent lime and anhydrous calcium sulfate. The lime, located in the core of the by-product particle, reacts with contaminated water that seeps through its calcium sulfate shell. The CaO in the by-product reacts quickly with orthophosphate. The removal efficiency of PO4 from phosphate contaminated water by by-products, as by high-calcium lime, is a function of sedimentation time. The efficiency of PO4 removal from raw waste water by the by-product is about the same as or better than that by high-calcium lime at the same CnO dosage level and sedimentation time. The by-product is better than high-calcium lime in turbidity removal from raw waste water. The use of the by-product to remove phosphate and turbidity from waste water makes the air pollution control process more economical. Pilot plant studies are planned to develop waste water treatment systems to work in coordination with the atmospheric control process.

*Waste water treatment, *Phosphates, *Turbidity, Economic efficiency, Lime, Calcium sulfate, Air pollution

Acid neutralization, Sulfur dioxide

D467
THE BIOLOGICAL PURIFICATION OF WASTE WATER IN CARROUSEL PLANTS (DIE BIOLOGISCHE REINIGUNG DES ABWASSERS IN CARROUSELANLAGEN),

Van Schagen, F. P., and Zeper, J.

Wasserwirtschaft, Vol. 65, No. 10, p 257-262, October, 1975. 7 fig, 3 tab, 6 ref.

The trend of the costs of construction and energy over the past twenty years has caused the development of increasingly large facilities for sewage treatment, using the Pasveer principles. This development has been significantly affected by the design of the Carrousel system. In this system, surface aerators are used for oxygenation and an orbital flow is generated at the same time, resulting in a series of completely mixed aeration zones and plug flow channels. In addition to the economical advantages of the Carrousel system, the efficiency of nitrogen removal is increased and simultaneous removal of phosphorus with Fe^{2+} can also be effected. After chemical conditioning, the aerobically stabilized sludge from a Carrousel plant can be dewatered on belt presses or on filter presses.

*Waste water treatment, *Sewage treatment, Aeration, Equipment, Treatment facilities, Flow, Nitrogen, Phosphorus, Nutrient removal, Sludge treatment, Dewatering

Carrousel system, Belt presses, Filter presses

D468
SPRAY RUNOFF DISPOSAL OF WASTE STABILIZATION POND EFFLUENT,

Ehlert, N.

Environment Canada Research Report No. 22, July, 1975. 24 p, 3 fig, 6 tab, 5 ref, 2 append.

An investigation of spray runoff techniques for land disposal of sewage effluents was conducted at the Smithville, Ontario, Canada, waste stabilization pond site. Although the study was originally designed to compare the irrigation-infiltration process to runoff disposal on a heavy clay soil with low permeability, it was also concerned with the runoff operation and effluent quality improvement. The waste stabilization pond effluent was sprayed on an area of soil with a slope of 5 percent, and a permeability, K less than or equal to 0.14 in/hr for two growing seasons. A combined waste stabilization pond-runoff system is capable of reducing the phosphorus loading on a receiving stream by 90%. The hydraulic input to the receiving stream may be reduced by 50% by this system. This system is feasible as long as the rates and duration of application do not result in soil erosion and/or damage to vegetation. The total phosphorus and BOD levels in the runoff satisfied the current discharge standards for sewage treatment plant effluents. However, the suspended solids levels exceeded the current limits, possibly because of minor erosion.

*Waste water treatment, *Municipal wastes, *Irrigation, Sprinkler irrigation, Runoff, Water quality, Waste water disposal, Permeability, Soils, Erosion

Land application

D469
OZONE CONTACT SYSTEM FITS INTO TIGHT GRIT CHAMBER,

Baratt, M., and Somerville, A.

New York City Department of Water Resources,
Bureau of Water Pollution Control.

Pollution Engineering, Vol. 7, No. 10, p 38, October, 1975.

The Manhattan Grit Chamber in New York City treats all sewage and storm drainage for 3253 acres of upper east side Manhattan. Pollution control facilities are being continually expanded and modernized. Methane and hydrogen-sulfide based odors had caused a serious problem and an ozone contact chamber was designed to oxidize the air and relieve the condition. While ozone contact chambers are ordinarily built with stainless steel supports and concrete walls, there was no property available to construct this type of a facility contiguous to the chamber. It was therefore decided to locate the contact chamber within the building. A combination of fiberglass reinforced plastic structurals supporting rigid baffles of polyvinyl chloride, reinforced with embedded steel wire, was constructed. These baffles, unaffected by the ozonated air, contributed to a weight savings. The ozone contact chamber measured 21 by 96 ft. An ozone generator was operated 24 hr/day, 7 days per week, producing ozone in a one percent concentration at a rate of 17.6 lb/day. Tube axial fans moved the odor-filled air through stainless steel ductwork up to the ozone chamber maze where it mixed with ozone. Minute organic particles were rendered inert and methane and hydrogen sulfide-based odors were eliminated.

*Ozone, *Odor, *Sewage treatment, *Treatment facilities, New York, Construction materials, Hydrogen sulfide, Methane, Air pollution, Waste water treatment

D470
TECHNIQUES FOR INDUSTRIAL ODOR CONTROL,

Cheremisinoff, P. N., Bethea, R. M., Hellman, T. M., and
Lauren, O. B.

Pollution Engineering, Vol. 7, No. 10, p 24-31, October, 1975. 6 fig, 4 tab.

The principal methods for controlling odors from manufacturing processes and sewage treatment are outlined. Physical containment of odors may be accomplished either by changing the process producing the odors or by improving maintenance. Various types of oxidation by combustion (direct combustion at 2500 F, thermal oxidation at 1000-1500 F, or catalytic oxidation at 600-900 F) have been popular; however, with rising fuel costs this control technique is no longer economically attractive. A common adsorption material for removal of both inorganic and organic odorants is activated carbon. Most organics with molecular weights greater than 45 and boiling points over 0 C will be adsorbed. Methods of odor removal by absorption were also compared. These could be achieved using ozone, chlorine, sodium hypochlorite, hydrogen peroxide, or potassium permanganate. Ozone has successfully been applied for the control of odors from waste water treatment facilities. Uses included oxidizing sulfides and amines to nonodorous sulfoxides and amino oxides in grit and screening chambers, aeration tanks, vacuum filters, and storage tanks.

*Ozone, *Odor, *Industrial wastes, *Sewage treatment, Waste water treatment, Oxidation, Chlorine, Adsorption, Absorption, Activated carbon, Treatment facilities, Economics

Physico-chemical treatment

D471
COLESHILL AWT WORKS--'A VERY DE-LUXE PLANT',

Surveyor, Vol. 146, No. 4348, p 9, October 10, 1975.

The Advanced Waste Water Treatment plant, an experimental works, has been built under NATO auspices at Coleshill, near Birmingham, Great Britain. The Coleshill works was built as a pilot plant and the goal of the project was to allow new techniques to be assessed under near full-scale conditions. The installation provides for two treatment streams, each with an average daily flow of 454 cu m. One stream is completely domestic, while the other sewer contains some industrial waste water. The fixed Coleshill installation will include inlet works, a services gantry, a reagent preparation plant, sludge dewatering equipment, monitoring, instrumentation, and a laboratory workshop, substation, and office buildings. Initially physical-chemical treatment will be examined; later other processes, particularly combinations of physical-chemical and biological treatment will be evaluated. The two process streams may be operated independently so that performance of the two processes may be compared simultaneously. A mobile modular concept will be used for the facility, so that operating conditions for individual units can be altered without changing the whole process, and units needing repair or modification can be removed and substituted. Work so far has concentrated on the use of chemically-aided settlement using available mixing, flocculation, and settling tanks. Further work involved the addition of lime together with ferric sulfate to one stream, with the other as a primary sedimentation control. The addition of chemicals has been found to significantly reduce the phosphate concentration.

*Tertiary treatment, *Pilot plants, *Waste water treatment, *Sewage treatment, Dewatering, Treatment facilities, Laboratory tests, Biological treatment, Flocculation, Lime, Settling basins

Physico-chemical treatment, Advanced Waste Water Treatment plant, Chemical treatment

D472
GREASE PROBLEMS IN MUNICIPAL WASTEWATER TREATMENT SYSTEMS,

Banerji, S. K., Robson, C. M., and Hyatt, B. S., Jr.

MCA Engineering Corporation,
Baltimore, Maryland,
Environmental Division.

In: Proceedings of the 29th Industrial Waste Conference, May 7-9, 1974. Purdue University, Lafayette, Indiana, p 768-781. 1 fig, 7 tab, 27 ref.

Problems of the discharge of industrial wastes with high grease, fat, or oil contents into municipal sewer systems were presented. Methods of analysis for grease, fats, and oils were reviewed, and available technology for removing this material from waste water and subsequent disposal methods were discussed. Two case histories were conducted. One compared pre-treatment of industrial waste water containing grease at the source versus providing grease removal facilities at a municipal waste water treatment plant. The second study described the economic analysis of two alternate pre-treatment systems for removal of grease from a poultry processing waste water. It was concluded that the present level of 100 mg/liter hexane or ether soluble grease and oil as a common limitation for municipal sewer ordinances should be re-evaluated. Any future grease or oil removal data or criteria should state the analytical procedure used. For example, if a solvent extraction method is used, the solvent should be identified. Additionally, when industrial wastes are treated at the source for grease or oil removal, the municipal sewer and waste water treatment plant operations will be reduced.

*Oil wastes, *Municipal wastes, *Waste water treatment, *Analytical techniques, Industrial wastes, Waste disposal, Sewers, Economics

*Grease, Municipal-industrial wastes

424

D473
EFFECTS OF DETERGENT FORMULATION ON WASTEWATER CHARACTERISTICS AND TREATMENT,

Shannon, E. E.

Black, Crow and Eidsness, Incorporated,
Gainesville, Florida.

Journal Water Pollution Control Federation, Vol. 47, No. 10, p 2371-2383, October, 1975. 11 fig, 7 tab, 17 ref.

Results of full-scale detergent substitution tests are presented, from a study: to assess the relationship between detergent formulation and phosphorus removal with calcium, aluminum, and iron salts; to assess the biodegradability of the detergent builder materials when they are subjected to biological treatment, and their impact on the efficiency of the biological waste water treatment process; and to assess the relative effects of four (NTA, citrate, carbonate, and phosphate) laundry detergent formulations on municipal waste water characteristics. These studies were carried out at the Canadian Forces Station, Gloucester, near Ottawa, Canada. It was found that by substituting nonphosphate detergents for existing detergents, an average reduction of 24% in total phosphorus content of domestic waste water was achieved. In a longer duration, larger-scale study, a 56% reduction was observed. Significant diurnal variations in waste water condensed phosphorus, NTA, citrate, sodium, silica, and alkalinity were seen, attributable to use of various detergent formulations. NTA was degraded by the activated sludge system, 61% under NTA substitution conditions. Winter and summer citrate removals over 60% could be expected from a well-operated activated sludge plant. The NTA-mercury, NTA-cadmium and NTA-nickel complexes showed poor degradability in a laboratory activated sludge system; in temperatures under 10 C, reduced NTA degradability may lead to increased metal levels in plant effluent. Detergent-induced increases in NTA or citrate levels did not have any quantifiable effect on phosphorus removal with alum, ferric chloride or lime.

*Environmental effects, *Detergents, *Waste water treatment, *Phosphorus, Biodegradation, Biological treatment, Carbonates, Canada, Activated sludge, Metals

NTA, Citrates

D474
PRIMARY-WASTE-TREATMENT METHODS,

Lash, L. D., and Kominek, E. G.

Envirotech Corporation,
Salt Lake City, Utah.

Chemical Engineering, Deskbook Issue, p 49-61, October 6, 1975. 14 fig, 4 tab, 12 ref.

Methods of primary treatment of waste water are dependent upon whether the effluent will be subjected to further treatment or whether it will be discharged to a municipal sewer system, a river, or a lake where its effluent quality must meet federal, state, and/or local standards. Fourteen types of primary treatment are detailed. These are: screening, centrifugal separation, neutralization, aeration, chemical oxidation, chemical reduction, precipitation, coagulation, gravity separation, induced-air flotation, dissolved-air flotation, media filtration, diatomite filtration, and ultrafiltration. Several of these treatment methods will reduce a given pollution load to within required limits, when used alone or in some combination. The decision to discharge wastes to a municipal sewer system for partial or complete treatment must be based on a comparison of capital and operating costs and sewer charges. The decision to install a treatment plant and its possible layout were discussed. Choice of waste treatment is dependent upon waste composition, including: acids and alkalis; suspended solids; fats, oils and greases; and dissolved solids, both mineral and organic. A selection among each of the fourteen primary waste treatment methods for removal of dissolved solids, suspended solids, and oil matter from waste waters must be based on physical and chemical properties of the stream. Layout of a waste treatment facility must be determined by the worst possible combination of flow and pollutant-load variation.

*Waste water treatment, *Industrial wastes, *Municipal wastes, Treatment facilities, Chemical precipitation, Oil wastes, Separation techniques, Filtration, Coagulation, Costs, Centrifugation

D475
EQUIPMENT FOR DEWATERING WASTE STREAMS,

Evans, R. R., and Millward, R. S.

Dorr-Oliver, Incorporated,
Stamford, Connecticut,
Environmental Technology.

Chemical Engineering, Deskbook Issue, p 83-87, October 6, 1975. 4 fig, 1 tab, 4 ref.

Various types of dewatering equipment are available to achieve desired concentrations of wastes for minimum costs of subsequent sludge handling. In selecting a particular dewatering technique, the specific process waste stream must be evaluated. The three general categories of waste sludges are primary solids, chemical precipitates, and biological solids. In petroleum refining, primary solids include oil-coated corrosion products, carbon, catalyst fines, sand, and silt. In the pulp and paper industry, sludge solids contain fibers and insoluble constituents, while in organic chemicals industry, primary solids may be unwanted byproducts, and used processing aids. The most common chemical precipitates generated during liquid waste treatment include metals. Biological sludges vary widely in characteristics, and thus require many types of dewatering equipment. The thickening characteristic of sludge, or sludge-volume index (SVI), from the activated sludge process may vary from 50 to 350. Evaluation of the alternatives for dewatering involves matching of process requirements and separation techniques. Various gravity thickeners, centrifuges, vacuum filters, and filter presses were compared. It was emphasized that engineers must develop their objectives (such as product parameters of solids in the liquid phase, and liquids in the solid phase) and define feed conditions (including solids concentration, density, and particle size), and base equipment selection on these data.

*Dewatering, *Waste water treatment, *Waste treatment, *Sludge treatment, *Oil wastes, *Chemical industry, Activated sludge, Equipment, Centrifugation, Separation techniques, Waste disposal

Sludge volume index (SVI), Sludge handling

D476
NITRIFICATION OF A HIGH AMMONIA CONTENT SLUDGE SUPERNATANT BY USE OF ROTATING DISCS,

Lue-Hing, C., Obayashi, A. W., Zenz, D. R., Washington, B., and Sawyer, B. M.

The Metropolitan Sanitary District of Greater Chicago, Illinois, Department of Research and Development.

In: Proceedings of the 29th Industrial Waste Conference, May 7-9, 1974, Part 1, Lafayette, Indiana, Purdue University, p 245-254. 5 fig, 7 tab, 9 ref.

When anaerobically digested sludge is stored in lagoons, awaiting use as fertilizer for strip-mined lands, a substantial layer of sludge lagoon supernatant (SLS) is formed. SLS has a relatively high concentration of NH3-N, making it undesirable for use on the land. The feasibility of nitrifying SLS using a rotating disc system (RDS) is discussed. The rotating discs provide an area for the attachment and growth of microorganisms and a means of aeration of the sludge. The objectives of the study were to determine whether a sufficient population of nitrifiers could be established on the discs to oxidize the ammonia waste water in a reasonable amount of time and to evaluate the ability of the RDS to act as an aeration-reaeration system. The total surface area of the discs in the RDS was 250 sq ft, and they rotated at a speed of 3 rpm. The temperature was kept at a constant 22 C. Since nitrification causes a destruction of alkalinity, pH had to be controlled and monitored. The RDS was monitored and sampled once a day, seven days a week. Various chemical analyses were run on influent and effluent samples, in order to monitor pH, biochemical oxygen demand, chemical oxygen demand, suspended and total solids, and the concentrations of ammonia, nitrates, nitrites and nitrogen. Results showed that NH3-N, at an overall loading of 25 lbs/1,000 cu ft/day was reduced by 99% by the RDS.

*Nitrification, *Ammonia, *Sludge, Biochemical oxygen demand, Chemical oxygen demand, Waste water treatment, Nitrates, Nitrites, Nitrogen, Alkalinity, Microorganisms, Suspended solids, Chemical analysis, Effluents, Lagoons, Anaerobic digestion, Strip mines, Monitoring

D477
THE UTILISATION OF SEWAGE SLUDGE,

Wood, R.

Effluent and Water Treatment Journal, Vol. 15, No. 9, p 455-457, 459-461, September, 1975. 4 tab, 9 ref.

The utilization of sewage sludge based upon its composition and properties is studied. It is difficult to define the properties of sewage sludge, since it comes in a wide variety of types, dependent on where it comes from, and what stage of processing it is in. Sludge can be utilized in methane production or fertilizer, both of which have been tried successfully. Proposed uses include wallboard manufacture, smokeless fuel production and metal recovery. It is uneconomical to recover metals from sewage sludge, but the high cost of metals could encourage recovery at the factory, before it becomes sewage. Agricultural uses of sludge have been interrupted since the Industrial Revolution because the concentrations of populations have produced more organic waste than the land can take back and industrial development has increased the amount of toxins or potential toxins in the sewage, making it undesirable to return it back to the land. Anaerobic fermentation processes have been successful in rendering most of these wastes environmentally acceptable. There are four problems and dangers of sludge use in agriculture: distribution, marketing, effects of external circumstances, and quality control of the product and its use. It is necessary to have strict controls and codes concerning the quality of sewage and its application to the land.

*Sewage sludge, *Sludge, Sewage treatment, Land use, Toxins, Anaerobic digestion, Pollutant identification, Waste water treatment, Waste disposal, Agriculture, Sludge disposal

Land application, Agricultural uses, Land treatment

D478
THE REMOVAL OF INORGANIC NITROGEN FROM SEWAGE EFFLUENTS BY BIOLOGICAL DENITRIFICATION,

Bailey, D. A., and Thomas, E. V.

Water Pollution Control, Vol. 74, No. 5, p 497-512, 1975. 13 fig, 5 tab, 54 ref.

Drinking water containing nitrate, when ingested by infants, can cause methaemoglobinaemia when the nitrate is reduced to nitrite by certain bacteria present in the infant's digestive tract. Of all nitrification and denitrification processes known, biological processes seem to be the best suited to the conditions and climate of the United Kingdom. Laboratory experiments carried out on biological denitrification are discussed. Certain types of heterotrophic bacteria, which are capable of altering their metabolism in order to use nitrate as a source of oxygen, are used in the processes. It was found that methanol and molasses were the most suitable candidates for sources of carbon; methanol was used in this study. Two different designs or process modifications were used: flooded biological filters and anaerobic or semi-anaerobic adaptations of the activated-sludge process. The flooded filters contained either 25 mm pebbles or 5 mm pebbles. The coarseness had no effect on the efficiency of nitrate removal; at retention periods of one hour, both reduced the nitrate content by about 90%. Temperature had the effect of retarding the process. Nitrate removal at 23 C was about 95% and at 7 C was about 48%, both after 8 days of operation. After 38 days of operation, 80% was removed at 23 C and 71% was removed at 7 C. The activated sludge processes are of two types: one in which a specific sludge is developed for denitrification alone and one in which a sludge is used for both nitrification and denitrification at the same time. Testing continues on their relative merit.

*Nitrogen, *Nitrates, *Nitrites, *Sewage, *Sewage effluents, *Effluents, *Denitrification, *Biological treatment, *Inorganic compounds, Filters, Sands, Bacteria, Potable water, Anaerobic conditions, Activated sludge, Sludge, Waste water treatment, Nitrification, Laboratory tests

Methanol, Molasses, Biological filters, Methaemoglobinaemia, Heterotrophic bacteria

D479
THE DESTRUCTION OF PARASITIC RESISTANT STAGES IN SLUDGE BY IRRADIATION WITH LOW ACCELERATING VOLTAGE ELECTRONS (DIE VERNICHTUNG PARASITAERER DAUERFORMEN IM KLAERSCHLAMM DURCH BESTRAHLUNG MIT NIEDERENERGETISCHEN ELEKTRONEN),

Enigk, K., Holl, P., and Dey-Hazra, A.

Zentralblatt fuer Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, I. Abteilung Originale Reihe B, Vol. 161, No. 1, p 61-71, 1975. 1 tab, 8 ref.

An investigation was performed on the effect of ionizing radiation on parasitic resistant stages in sludge. An electron beam accelerator can be used for this process. The accelerator is provided with energy from an electric power supply network which can be switched on and off according to the requirements. These units have a large beam capacity and high operating safety. The process is conducted with a continuous flow and at room temperature. The effect of different radiation doses was tested in 13 experiments. An economically acceptable dose of 480 kRad (accelerating voltage: 400 kV, beam current: 10 mA, and irradiation time: 24 sec) can be easily achieved in practical situations. Approximately 97% of the following parasitic stages have been destroyed by a 480 kRad dose: undeveloped eggs of Ascaris suum, Trichuris suis, and Fasciola hepatica; gastrointestinal strongylids of pigs; and, embryonated eggs of Capillaria obsignata and Taenia spec. A few third-stage larvae of Oesophagostomum (Strongylidae) of pigs survived 108 sec of irradiation, however, these did not develop to maturity in the definitive host. About 25% of the sporulated oocysts of Eimeria tenella were still infective after 108 sec of irradiation.

*Waste water treatment, *Sludge treatment, *Irradiation, Disinfection, Parasitism, Radiation

*Ionizing radiation, *Electrons

D480
ALUM TREATMENT OF HIGH-RATE TRICKLING FILTER EFFLUENT AT CHAPEL HILL, NORTH CAROLINA,

Brown, J. C.

North Carolina University, Chapel Hill,
Department of Environmental Sciences and Engineering,
Wastewater Research Center.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 153-177. 8 fig, 9 tab, 8 ref.

Promising results achieved by adding alum to the trickling filter effluent at a plant at Richardson, Texas, encouraged the EPA to contract the UNC Wastewater Research Center to experiment with alum addition at the high-rate trickling filter facility at Chapel Hill's (North Carolina) Mason Farm Treatment Plant. Treatment of high-rate trickling filter effluent with alum is an effective measure to upgrade plant performance and improve phosphorus removal. Alum dosages between 165 and 250 mg/liter and Al:P mole ratios between 1.5 and 2.2 were effective at the Chapel Hill plant. A combination of alum and organic sludge can be satisfactorily anaerobically digested. Decreases in pH and digester alkalinity were corrected by the addition of lime. Recommendations include: additional final settling tank capacity; a design overflow rate of 500 gpd/sq ft, based on an average daily flow; a flow paced alum feeding system for alum application; and, separate facilities for handling the alum-humus sludges from final settling tanks. The separate sludge handling facilities are recommended because of the increase in wet digester sludge resulting from the addition of alum. If the entire Chapel Hill plant flow were treated with alum, the sludge volume would increase about 2.4 times normal. Alum addition to trickling filter effluent can result in BOD removal of 95%, and phosphorus removal of 90%.

*Waste water treatment, *Treatment facilities, *Trickling filters, Sludge, Sludge treatment, Anaerobic digestion, Biochemical oxygen demand, Phosphorus

Alum

D481
OXYGENATION EQUIPMENT--AERATORS AND PURE OXYGEN SYSTEMS,

Tyer, B. R., and Hayes, C. H.

Bernard Johnson, Incorporated,
Houston, Texas,
Environmental Projects.

Chemical Engineering, Deskbook Issue, p 75-77, October 6, 1975. 1 fig, 11 ref.

Various types of aeration equipment (mechanical aerators, diffuser aeration systems, brush aerators, venturi aerators) have been manufactured in the past few years. Onsite performances of several installed aerators used to oxygenate water were evaluated. The process design for direct oxygenation (using the UNOX system) as compared to air oxygenation, requires information on waste water quality and quantity, the required effluent quality, and relationships between the direct oxygen unit and other plant operations. In Batavia, New York, a demonstration project was performed to obtain comparative economic data on air and direct oxygenation systems. Results indicated a savings with direct oxygenation; costs for a one mgd plant were projected as $0.12-$0.135 per lb of dissolved oxygen for direct oxygenation and $0.135-$0.165 for air, while those for a 100 mgd plant were $0.085-$0.095 for direct oxygenation and $0.105-$0.125 for air. In reaeration of the Ruhr river in Germany, however, air as the source of O2 was found to be more efficient. In another case, on the Great Miami River, Ohio, results of an instream aeration experiment with air and oxygen were reported. Direct oxygenation had the advantages of: a theoretical solubility advantage of 5:1 over air, the least disturbance to the water, the potential for supersaturating sidestreams with O2, and a cost of $0.084/lb of dissolved oxygen for direct oxygenation, as compared to $0.096/lb for surface aeration and $0.115/lb for air diffusion.

*Oxygenation, *Aeration, Equipment, Installation, Economics, Rivers, Waste water treatment, Water quality, Costs, Treatment facilities

Direct oxygenation

D482
LATEX PAINT WASTES--MUNICIPAL CHARGES AND TREATMENT,

Williams, R. T.

East Bay Municipal Utility District,
Oakland, California.

In: Proceedings of the 29th Industrial Waste Conference, May 7, 8, and 9, 1974, Purdue University, Lafayette, Indiana, p 383-393. 13 tab, 9 ref.

In view of federal regulations, the East Bay Municipal Utility District, Oakland, California, investigated the contribution of the latex paint manufacturing industry to the waste waters discharged to its municipal sewer system. The new regulations require municipal treatment agencies receiving construction grants for water pollution control facilities to recover from all industries their portion of the grant amount. The municipal agency receiving the grant must also adopt an equitable system of cost recovery reflecting the cost of treating the volume and quality parameters of the waste water. They also must define and enforce source control regulations on the industrial users. The strength characteristics and treatability of latex wash water were evaluated. Two treatment processes used at municipal plants were compared for efficiency, cost allocation, and revenue requirements. The rates charged the paint industry by the municipal agency for each process may be assessed or determined either on a surcharge basis or on a quality and quantity formula. Using a surcharge, the concentrations greater than 200 mg/liter of suspended solids and 400 mg/liter COD are computed, whereas the rates for a quality and quantity formula are assessed on the unit rates for volume and strength of the discharge. Latex is treatable either at the industrial facility or later by the municipal agency. The choice of treatment must be decided on a case-by-case basis, considering municipal effluent requirements, design criteria, and the proportion of industrial waste in the municipal plant effluent.

*Legislation, *Industrial wastes, *Sewers, *Municipal wastes, Construction costs, Operating costs, Waste water treatment, Chemical oxygen demand, Suspended solids, Water pollution control

D483
RE-USE OF SEWAGE EFFLUENT AND SLUDGE,

Francis, A. J., Coldrick, J. R., and Stonebridge, H. A.

Journal of the Institution of Water Engineers and Scientists, Vol. 29, No. 4, p 196-200, June, 1975. 13 ref.

The prospects for reuse of sewage effluent and sludge in Great Britain were examined. The annual expenditure on sludge disposal is L10 to L20 million; with proper reclamation of water, gas, and specific chemicals, this sludge might be made to yield a profit. Several examples of economic reuse were provided. In one case, 3 mgd of water recovered from sewage effluent (after secondary treatment) has been sold to local industry by the Avonmouth sewage treatment works for a yearly return of L61,000. Sewage sludge has been used as a soil conditioner or fertilizer but must be closely monitored for heavy metal content. Several facilities where sludge is dried and sold to farmers and market gardeners are described. Another example of reuse is the utilization of the methane gas produced by sludge digestion. At many sewage treatment works this gas is collected to power dual-fuel generators and turbines. Protein from activated sludge has been separated and fed to animals as a nutritional supplement. Specific organic chemicals (proteins, amino acids, nucleic acids, enzymes and vitamins) might also be extracted. Additionally, grease (from municipal-industrial waste streams) combined with sewage effluents has been recovered at the Esholt Works, Bradford and has been resold to industry as a fuel oil. Other miscellaneous products of sewage and sludge include paper, oil, plastics, and adsorbents. To achieve an optimal reclamation of these resources, support in marketing and publicity by the Regional Water Authorities and the national government is needed.

*Recycling, *Water reuse, Sewage effluents, Sewage sludge, Sludge disposal, Waste disposal, Activated sludge, Water resources development, Organic compounds

Municipal-industrial wastes

D484
LAND TREATMENT VERSUS CONVENTIONAL ADVANCED TREATMENT OF MUNICIPAL WASTEWATER,

Young, C. E., and Carlson, G. A.

Pennsylvania State University,
University Park,
Natural Resources Economics Division.

Journal Water Pollution Control Federation, Vol. 47, No. 11, p 2565, November, 1975. 1 fig, 1 tab, 16 ref.

Land treatment by spray irrigation was compared with conventional in-plant advanced treatment of municipal waste water. Multiple regression analysis was used to examine the cost structure of existing waste water treatment plants by adjusting for regional variations. Statistical cost curves were estimated by including the rate of flow capacity used and the degree of treatment. A cost model was developed and applied to data collected from 125 United States cities, 50 of which used land treatment. Land application of waste water seemed to be a lower-cost alternative for the communities sampled. Conclusions reached were that: for both land and conventional technologies, annual costs decrease as flow through the facility increases, implying that consolidated treatment districts should be examined for possible economies of size. Costs increase at an increasing rate as higher degrees of treatment are required. In addition, a proportional increase in reserve capacity causes a greater percentage increase in costs for advanced treatment than for primary or secondary treatment, implying that planners must make accurate population and flow projections. Also, increases in per unit energy prices will cause increases in annual costs for both types of treatment. The cost estimate, however, for the combination treatment system is less sensitive to factor price increases than is the cost of the conventional treatment system.

*Waste water treatment, *Waste disposal, *Tertiary treatment, Municipal wastes, Model studies, Costs, Statistical methods, Regression analysis, Treatment facilities

D485
WATER AUTHORITIES' RESEARCH NEEDS,

Stott, P.

Water, No. 5, p 16-26, October, 1975.

Research needs were outlined by the Water Research Center (WRC), Great Britain, for the areas of water treatment and quality, sewage treatment, coasts and estuaries, water distribution and sewerage, sludge treatment and disposal, resources management, and fisheries and recreation. Problems and priorities were defined; the recommendation that the WRC and Water Authorities (WAs) work cooperatively was made. The dominant problems for water and waste water treatment are economics and water quality. Quality problems in water treatment are often linked with distribution. For England and Wales, assessing water treatment costs was difficult because marginal treatment costs will be higher than present treatment costs. It was found, however, that water treatment costs are less than sewage treatment costs and of a lower order of magnitude than the costs of water mains. Cost-effectiveness is central to the problems in sewage treatment. The capital investment in new and extended sewage works is now over L1000 m per year. Savings could be achieved in the operation and maintenance of small sewage works if more data were obtained on their tolerance to loading variations. In the field of sewers and water mains, operational problems directly influence costs. Current spending on pipes by WAs represents more than half their capital investment and the improvement of technology and materials has a high priority. Sewage sludge treatment and disposal, which now requires an annual capital expenditure of over L35 m, may be improved by encouraging research in agricultural applications or in the recycling and reuse of sludge by-product.

*Research and development, *Water treatment, *Sewage treatment, *Waste water treatment, Water resources development, Water quality, Economics, Recycling

Cost-effectiveness, Water Authorities (Great Britain)

D486
RECYCLE OF LIQUOR FROM HEAT TREATMENT OF SLUDGE,

Boyle, J. D., and Gruenwald, D. D.

CH2M Hill Incorporated,
Corvallis, Oregon.

Journal Water Pollution Control Federation, Vol. 47, No. 10, p 2482-2489, October, 1975. 2 fig, 5 tab.

A newly expanded waste water treatment plant at Colorado Springs provides activated sludge treatment for wastes including high-strength recycle liquors from a sludge heat treatment system. The concept of the plant design and the operational experiences for its first year of service are described. Process difficulties which have been eliminated were those associated with the illegal discharge to the city sewers of chlorinated hydrocarbon and organic phosphorus insecticides. A continuing operational problem is foam on the secondary clarifier, probably due to handling of scum skimmings in the heat treatment process. The total cost of expanding the treatment facility was $8,490,000, which included the heat treatment system, engineering, legal, and administrative work. "Hidden costs", such as the aeration power increase caused by the heat treatment recycle liquor, were also analyzed. It was difficult to compare the costs of this system on a unit cost basis with the costs of other solids conditioning systems because of the effect of the recycle streams. The total costs of the heat treatment system, allowing for recycle effects, was found to be approximately $40 per dry ton of virgin solids. The heat treatment recycle liquor BOD contributed about 21% of the influent BOD load and about 30% of the suspended solids load.

*Activated sludge, *Waste water treatment, *Treatment facilities, Recycling, Heat treatment, Sewers, Costs, Biochemical oxygen demand, Suspended solids

D487
ASPECTS OF WATERWORKS PUMPING PLANT DESIGN,

Sharma, G. N.

Journal of the Institution of Water Engineers and Scientists, Vol. 29, No. 3, p 148-154, May, 1975. 6 tab.

Design problems for Rotodynamic pumps were discussed. Hydraulic and electrical considerations vary, according to the pump type and its specific speed. Operating costs of an installation far exceed initial plant cost and the pump peak efficiency margin is not widespread. Specific cases comparing the performance and annual running costs (ARC) of typical pumps were illustrated, based on 8750 hours at 0.70 per KW. In an example, one submersible pump installed in a borehole had a capital cost of L1625, an efficiency of 65.2%, KW input of 62.4, and an ARC of L3820, while its counterpart, with a capital cost of L2000 had an efficiency of 68.5%, KW input of 59.5, and a lower ARC (L3640). Therefore, while the initial capital cost of the first model was higher by 375 pounds, it showed an annual savings of 180 pounds and would be cheaper by its third year of operation. A study comparing two horizontal spindle type surface pumps showed a less dramatic annual savings in operating costs and a longer period for initial cost recovery. However, a pump arrangement using a submersible borehole type and a surface type in series might prove to be economical. Financial gain in operating costs is also dependent on the percentage of total head that the more efficient surface pump is required to generate.

*Pumps, *Operating costs, *Capital costs, Economics, Hydraulics, Design criteria, Hydraulic equipment

Rotodynamic pumps

D488
DESIGN AND OPERATION OF HIGH-RATE FILTERS-PART 1,

Kawamura, S.

James M. Montgomery, Consulting Engineers, Incorporated, Pasadena, California, Water Treatment Division.

American Water Works Association Journal, Vol. 67, No. 10, p 535-544, October, 1975. 7 fig, 3 tab, 35 ref.

Experience with high-rate filtration, available formulas, and design criteria are discussed in order to assist in economical filter design and operation. Topics covered include: historical development of filtration, degree of pretreatment necessary when using conventional rapid sand filters and reverse-graded filters; selection of the filter media; required filter media thickness relative to the media grain size; filter rate control; maximum head loss for filters; and, continuous turbidity monitoring. The main goal in filter design is to provide a facility for the steady production of high-quality water with minimum operational and maintenance costs. The new types of media, filter wash systems, chemicals for filter aids, or different concepts of filtration now available require the use of new design criteria. Pretreatment and filtration are closely related; design of pretreatment facilities should depend on the type of filter employed. Selection of filter media should be based on the degree of purification required, the length of filter run, and ease of filter wash to remove lodges suspended matter from filter media. The absolute minimum depth of total filter media should be 300 m in order to provide a safety factor against breakthrough. Filter rate control is divided into five basic types: constant rate filtration; declining rate filtration; constant level filtration; equal loading filtration; and, constant pressure filtration.

*Waste water treatment, *Water treatment, *Filtration, *Filters, Equipment, Design criteria, Operation and maintenance, Economics, Costs, Design, Filter rates

High-rate filtration

D489
TERTIARY WATER TREATMENT,

Plant Engineering and Technology, p 38, 1975.

Toray Engineering Company, Limited, of Japan has built an advanced waste water treatment pilot plant at their Shiga factory. The company plans to branch out into selling tertiary sewage and waste water treatment technology. The pilot plant was designed combining some of the technology developed by CH2M Hill with the BIOX rotating disc aerator developed by Toray Engineering. Waste water receives secondary treatment by means of the BIOX rotating disc aerator. Tertiary treatment includes lime coagulation, carbonate formation, filtration, break-point chlorination, and activated carbon adsorption. Ammonia-nitrogen is decreased to 0.2 ppm, BOD to 1-2 ppm, COD to 1-2 ppm, SS to one ppm, and total phosphorus to 0.06 ppm. The treated water can be used as potable water after chlorination. The waste water is treated in the rotating disc aerator to a degree that is half-way between that of secondary and tertiary treated water. This decreases the consumption of activated carbon and lowers the operating costs. Recycling of calcium carbonate, simplification of ammonia removal, and regeneration of activated carbon are also stressed in the treatment process. The pilot plant costs $330,000 and treats 60 tons of waste water from the cafeterias and dormitories of the Shiga factory.

*Waste water treatment, *Sewage treatment, *Treatment facilities, *Pilot plants, *Tertiary treatment, Lime, Coagulation, Filtration, Chlorination, Ammonia, Phosphorus, Nutrient removal, Nitrogen, Activated carbon

BIOX rotating disc aerator

D490
MARSH MILLS-THE NEW WORKS TREATING SEWAGE FROM PLYMOUTH,

Surveyor, Vol. 146, No. 4345, p 39-40, September 19, 1975. 2 fig.

The first and second stages of the Marsh Mills sewage treatment works of the South West Water Authority (Great Britain) have been completed at a cost of 900,000 pounds. The first stage, primary treatment works, superseded the primary treatment facility built in 1957. The second stage provides secondary treatment and automatic control. The main problem with the design of the sedimentation tanks was flotation of the tanks because they extended 6.5 m below the normal groundwater level. Prevention of flotation is accomplished by a combination of pressure relief valves to prevent the groundwater from rising above a specific level when the tanks are empty, and ground anchors to resist the residual upthrust. The main pumphouse is a reinforced concrete frame building with brickwork infill walls. It contains two comminutors, two 250 mm and three 175 mm main sewage pumps, two 200 mm diameter reciprocating sludge pumps, grit tank blowers and switchgear, and staff accomodations. There are standby sets for all pumps, blowers, and comminutors. Overall control of the works is from the pumphouse; most daily operations can be performed automatically. Automatic functions include: separation of storm water; monitoring and returning storm water to the main flow during low flow periods; sludge drawoff; sludge pumping and measurement; monitoring of return and surplus sludge; and, aeration control. Secondary treatment is provided by four Simplex aeration cones; the amount of aeration is controlled by dissolved oxygen electrodes in the tank.

*Sewage treatment, *Waste water treatment, *Storm water, *Treatment facilities, Automatic control, Pumps, Pumping plants, Automation, Aeration, Monitoring

D491
TEMPERATURE EFFECTS ON AEROBIC DIGESTION KINETICS,

Randall, C. W., Richards, J. B., and King, P. H.

Virginia Polytechnic Institute, Blacksburg,
Department of Civil Engineering.

Journal of the Environmental Engineering Division - ASCE, Vol. 101, No. EE5,
p 795-811, October, 1975. 11 fig, 9 tab, 23 ref, 1 append.

Research was conducted to determine under controlled conditions the effects of a wide range of digestion temperatures on the aerobic digestion process and the subsequent dewaterability of the resulting digested sludges. Waste activated sludge was digested in batch reactors for 15 days at temperatures of 5, 10, 30, 35, and 45 C. The selection of an optimum temperature depends on the principal goal to be achieved; however, neither 5 or 45 C should be selected as an aerobic digestion temperature if batch reactors are used. The water quality from the 20 C reactor was slightly better, but there was little difference in quality from 10 to 35 C. Stabilization of the mixed liquor was best at high temperatures. The oxygen required per unit volatile solids destroyed was lowest at the low temperatures. Optimum filterability occurred at a digestion temperature of 35 C. Maximum solids destruction occurred in the 20 C reactor. Generally, there was not much difference in the performances of the 20, 30, and 35 C reactors. The kinetics of digestion were in good agreement with accepted temperature variation theory for the reactor temperatures at 20 C and below. However, the values from the digesters operated at higher temperatures do not conform at all. Above 20 C, the endogenous destruction of waste activated sludge cannot be described as a chemical reaction; environmental factors and population dynamics considerations are more important. There seems to be no practical advantage to aerobic digestion temperatures higher than 20 C.

*Waste water treatment, *Activated sludge, *Kinetics, Temperature, Aerobic conditions, Laboratory tests, Analytical techniques

Aerobic digestion

D492
USE OF POLYELECTROLYTES FOR OVERLOAD CLARIFIERS,

Benedek, A., Bancsi, J. J., and Rupke, J. W. G.

McMaster University, Hamilton, Ontario, Canada,
Department of Chemical Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 10, p 2447-2460,
October, 1975. 14 fig, 3 tab, 10 ref.

Agreement between Canada and the United States requires the removal of phosphorus by waste water treatment plants in the Lower Great Lakes Region. The batch settling properties of an alum-polyelectrolyte waste water system is examined in the laboratory and the clarifier performance is predicted in full scale. Full-scale data with primary alum and polyelectrolyte addition on the chosen water pollution control plant at overflow rates is obtained to predict the maximum permissible hydraulic loading for a primary clarifier. The laboratory predictions are compared with the results of the full scale study. In the batch settling procedure, alum was added at time zero, and then, five minutes later, the polyelectrolyte was added. The system was rapidly mixed for the first five minutes and slowly mixed the next fourteen minutes, after which samples were taken at preset intervals. This simulated the plant study, in which alum was added in one part of the line and polyelectrolyte was added further downstream. Samples were analyzed for total and filtered phosphorus, total and filtered chemical oxygen demand, and suspended solids. Samples were frozen for preservation, but this introduced about a 40% error into the suspended solids determination. The standards for effluent phosphorus concentration that had to be met were one mg/liter 80% of the time in jar tests and 50% of the time in plant operation. In the batch settling tests, alum with polyelectrolyte reduced phosphorus concentrations by 44% more than alum alone and increased overflow rates. In the activated sludge plant, the phosphorus, suspended solids and chemical oxygen demands were reduced and the overflow rate was increased.

*Polyelectrolytes, *Overflow, *Waste water treatment, Activated sludge, *Suspended solids, Phosphorus, International waters, Laboratory tests, Chemical oxygen demand

D493
PROCESS CONTROL BY OXYGEN-UPTAKE AND SOLIDS ANALYSIS,

Benefield, L. D., Randall, C. W., and King, P. H.

Mississippi State University,
State College,
Civil Engineering Department.

Journal Water Pollution Control Federation, Vol. 47, No. 10, p 2498-2503, October, 1975. 2 fig, 6 ref.

The most common methods used by plant operators to control the activated sludge process are discussed. The theoretical basis for another method having certain advantages over the others was studied. Four control methods in common use are: sludge wasting to maintain a constant mass of organisms in the system; sludge wasting to maintain a constant specific rate of substrate utilization; sludge wasting to maintain a constant sludge age; and, hydraulic control to maintain a constant sludge age. The last two, in which the sludge age is kept constant, are the most favorable ones. The major weakness in these methods is the continual shifting in the solids balance between the aeration tank and the clarifier as the influent flow rate deviates. A new method is proposed in which the solids separate at a rate such that the required solids concentration is maintained in the sludge return lines and no microbial growth occurs in the secondary clarifier. Advantages of this method include: the effect of the fluctuating solids level in the secondary clarifier is minimized; any change in the influent substrate concentration will be reflected immediately in the oxygen uptake rate; and loading fluctuations can be compensated for by varying the interval between control periods. Disadvantages of this method include: the requirement for a laboratory study to determine changes in the constants; more operator attention than is required in the hydraulic method for controlling sludge age; and more mathematical manipulations are required than in any other of the methods.

*Oxygen, *Solids contact processes, *Waste water treatment, *Activated sludge, Analysis, Sludge treatment, Microorganism, Mathematics, Control systems

*Process control, *Oxygen-uptake, *Solids analysis, Clarifiers, Sludge age, Sludge wasting, Hydraulic control, Substrate concentration

D494
MICROSCREENING AND DIATOMITE FILTRATION,

Syrotynski, S., and Stone, D.

Albany, New York State Department of Health.

American Water Works Association Journal, Vol. 67, No. 10, p 545-548, October, 1975. 3 fig, 7 tab, 3 ref.

Four microscreening units have been installed in New York State since 1961 as pretreatment processes. The existing water quality information as related to the performance of these units in New York is studied and the microscopic-removal performance of a water plant using a microscreening-diatomaceous earth-water treatment process is evaluated. Previous studies on microscreens have found a 90.4% average reduction in plankton concentration; a 44.6% average reduction in the concentration of total microscopic particles; and, a microstrainer effluent with a more uniform concentration of plankton and total microscopic count than present in raw water. Tests in New York have found that microscreening is effective in removing microscopic particles and that diatomaceous earth filters are even more effective, but if there are excessive total counts of microscopic particles, the filtration times would be cut down. These two methods were tested in conjunction in the Geneva, NY, water supply system. Six filtration cycles were used in the tests. Analyses were conducted pre- and post-microscreening and after diatomite filtration. These tests showed that the use of microscreening as a pretreatment process lengthened the filter runs for the diatomite and slow sand filters. Diatomite filtration achieves more acceptable levels of microscopic particles than microscreening. Data are too limited to compare the efficiency of removals by different sized microscreens.

*Diatomaceous earth, Microorganisms, Plankton, Water treatment, Filtration, New York, Treatment facilities, Pre-treatment (water), Analysis, Screens

*Diatomite filters, *Microscreening, Microscopic particles, Geneva (N. Y.)

D495
DYNAMICS OF NITRIFICATION IN THE ACTIVATED SLUDGE PROCESS,

Poduska, R. A., and Andrews, J. F.

Tennessee Eastman Company,
Kingsport.

In: Proceedings of the 29th Industrial Waste Conference, May 7-9, 1974, Lafayette, Indiana, Purdue University, p 1005-1025. 15 fig, 8 tab, 36 ref.

The transient responses of a nitrifying activated sludge process to various dynamic forcings in continuous flow laboratory scale reactors were studied. A dynamic model of nitrification in the activated sludge process was developed and verified with data taken in the study. Two types of bacteria are responsible for nitrification: Nitrosomonas oxidizes ammonium to nitrite, and Nitrobacter oxidizes nitrite to nitrate. These bacteria survive well in domestic wastes but not in industrial wastes because of growth inhibiting chemicals and adverse pH conditions. Proper sludge age, pH, temperature and dissolved oxygen concentration are necessary for the survival of the bacteria. Stochiometric analysis was performed to determine the necessary dissolved oxygen concentration. A kinetic mathematical model provides a theoretical basis for nitrification. The dynamic model in the study uses the Monod relationship between specific growth rate and substrate concentration. The differential equations are solved by computer. Three identical systems were used to test the dynamic model. The temperature was kept at a constant 23 C and the pH was kept at a constant 7.2. A mixed culture of nitrifying bacteria and heterotrophic bacteria was used. The dynamic model adequately represents the dynamic responses of nitrification in the experimental system for various input forcings. Sludge age is the basic parameter for determining the degree of nitrification in an activated sludge system.

*Nitrification, *Activated sludge, *Waste water treatment, Nitrate, Nitrite, Nitrogen, Ammonia, Mathematical models, Continuous flow, Dissolved oxygen, Bacteria, Industrial wastes, Domestic wastes, Sludge treatment, Oxidation

Monod relationships

D496
WASHINGTON SEWAGE WORKS: DESIGN AND OPERATION,

Eno, J. M., and Pollington, D. C.

Water Pollution Control, Vol. 74, No. 5, p 571-583, 1975. 3 fig, 8 tab, 10 ref.

The New Town of Washington (Great Britain) was designated in 1964. The development, design and operation of the sewage treatment works is discussed. Prior to the planning of the new town, sewage, mostly domestic but some industrial, was dumped virtually untreated into the River Wear. The new Northumbrian River Authority imposed treatment standards that were compatible with light industry. Wide variations in the flow rates along with the presence of high suspended solid concentrations from a coal washing plant caused initial problems. During Stage I development, two communitors and one detritor were installed to control the suspended solids. Two twin side-weir storm-sewage overflows, a new flow metering system and three twin rectangular primary sedimentation tanks were added to handle the flow variations. Sewage sampling over the years indicates that the strength of the sewage is decreasing, mainly because of the increase in modern housing. A temporary pumping station was built for sludge disposal. Cost analyses were performed on various sludge disposal methods. A tanker was purchased and the sludge was temporarily transported to sea. Sea disposal through pipes was most likely to be adopted. Industrial waste waters contained grit from the colliery, cyanide, phenol, and various metals including iron, copper, chromium, nickel and zinc. Industrial effluents were controlled by the consent procedure. In Stage II development, increased population made secondary treatment necessary. Two aeration units and four final settling tanks were added and the flow apparatus was automated. A central processor is used for continuous surveillance, data recording and plant control.

*Operation and maintenance, *Treatment facilities, Sewage disposal, Sewage treatment, Storm water, Flowmeters, Suspended solids, Waste water treatment, Waste water disposal, Sludge treatment, Sludge disposal, Sedimentation, Detritus, Pumping, Domestic wastes, Industrial wastes, Metals, Cost analysis

New Town of Washington (Great Britain), River Wear (Great Britain), Detritor, Comminutor, Colliery

D497
OZONE FIGHTS ODORS,

Water and Wastes Engineering, Vol. 12, No. 10, p 39, October, 1975.

An odor control system has been installed in a new 20 mgd sewage treatment facility in Savannah, Georgia. The Savannah Water Pollution Control plant handles about 12 mgd of sewage effluent. Approximately 30,000 cfm of air containing gas and odors is drawn off the screen room and grit chambers through fiberglass ducts and fed into a contact chamber. Ozone is injected into the air stream, with a contact time of about 6.3 seconds. Ozonated air is exhausted into the atmosphere through a duct in the ceiling of the chamber. Any airborne sulfides, amines, or mercaptans are oxidized and the exhausted air is odorless and germ-free. The ozonator for this facility uses atmospheric air, and produces over 25 lb/day of ozone. Ozone is discharged from the ozonator at a pressure between 3 and 7 psig, through stainless steel pipe directly into the exhaust duct.

*Ozone, *Odor, *Waste water treatment, *Sewage treatment, *Treatment facilities, Equipment, Sewage effluents, Georgia

D498
WATER OZONATION PLANT AT WROCLAW (Stacja ozonowania wode we Wroclawiu),

Jasinski, B., Madrecka, A., Olech, A., and Wichlinska, K.

Gaz, Woda i Technika Sanitarna, Vol. 49, No. 6, p 187-191, 1975. 11 fig, 3 ref.

An ozonating station for water treatment is described. Its chief components are ozone generators and contact tanks. Each generator consists of a cylindrical stainless steel body with steel tubing containing dielectric pipes. The tubing is connected with two chambers, one of which is fed dry air, while the other accumulates ozonated air. A ring-shaped space between the metal and dielectric tubing is maintained in which air or oxygen is converted into ozone by means of an electrical discharge. Contact between ozonated air and water occurs in the contact tank which is made up of three parallel-arranged contact chambers. Each chamber has five compartments and water contact occurs between the first and the second and between the fourth and the fifth compartments of each chamber. Ozone is supplied to the second and third compartments, where excess ozone in the water is first produced and then maintained. This arrangement results in a level of 2 mg/liter of ozone at a daily output of 180 cu m over a period of 21 min in the three parallel-arranged chambers. Ozone utilization achieves a quality of water conforming to health regulations, reduces color, returns normal odors, and normalizes bacterial composition in the water. Further, it eliminates the need for initial chlorination and reduces the doses of final chlorination to the prophylactic level, thus limiting corrosive conditions due to the Cl2 effect. The mean atmospheric ozone concentration in the ozonating station is between 0.02 and 0.15 mg/cu m.

*Water treatment, *Ozone, Treatment facilities, Tanks, Equipment, Odor, Chlorination

D499
ELECTROLYTIC DEPHOSPHORATION AND DENITRATION,

Plant Engineering and Technology, p 38, 1975.

A new technology for removing phosphorus and nitrogen compounds from sewage and plant waste water has been developed in Japan. Electrolysis is used to change the phosphorus and nitrogen compounds contained in water into non-watersoluble sludge, with a nearly 100% removal rate. Waste water is electrolyzed while being mixed with activated diatomaceous earth obtained from electrolysis and sea water which has been subjected to preliminary electrolysis at a pH below seven. Phosphorus compounds and ammonia are adsorbed on the activated diatomaceous earth. Phosphorus compounds are changed into calcium phosphate by reaction with calcium compounds dissolved in the water. Previous methods of tertiary treatment have included: a body-feed method in which activated carbon powder is used as adsorbent, a method making use of synthetic zeolite adsorbent, and a method using an anthracite adsorbent. These cost about 30 yen per ton of water to be treated. In comparison, the electrolysis method costs less than ten yen for one ton of waste water and operates very quickly.

*Nutrient removal, *Electrolysis, Tertiary treatment, Activated sludge, Waste water treatment, Adsorption, Phosphorus, Nitrogen, Adsorption

D500
NEW PLANT SOLVES SEASONAL PROBLEM,

Allen, H. S., and Flett, D. R.

Water and Wastes Engineering, Vol. 12, No. 10, p 23-25, October, 1975. 1 fig.

Problems due to seasonal variations in sewage flow at a secondary treatment plant at Ortley Beach, New Jersey, were solved by a combination of ozone and automation. The treatment facility, located close to homes in a recreational community, was expanded from its 6 mgd primary capacity to a 12 mgd secondary capacity. Main components of the new system are a main influent pump station with mechanical bar screens and grinders. Sludge production in winter is about 60% of the summer load. The secondary digester is used as a holding tank, allowing the final step in sludge treatment (vacuum filtration) to proceed at a constant rate. Following digestion, air from primary, aeration, and sludge thickening tanks is fed to an ozone building for odor control treatment. Two ozone generators each produce 17 lbs ozone per day. Operations of the treatment process are monitored by an analog computer system which also provides data on the plant operation.

*Sewage treatment, *Ozone, *Control systems, Computers, Sludge treatment, Treatment facilities, Waste water treatment, Digestion tanks, Odor, New Jersey

Secondary treatment

D501
WASTE SLUDGE TREATMENT WITH PRESSURE FILTRATION,

Forster, H. W.

Passavant Corporation,
Birmingham, Alabama.

Filtration Engineering, Vol. 6, No. 6, p 9-12, September/October, 1975. 3 fig, 1 tab.

Liquid-solid separation requires a force to drive the liquid through the accumulated solids. Pressure filters require a pressure differential from three atmospheres to a multiple of that force for operation. For higher multiples, the term high pressure filtration is often used. This term is misleading in that it implies danger to personnel and high operating costs. The inaccuracy of this myth is dispelled in this study. Two methods of filter cake disposal are discarding it on a landfill and incinerating it and discarding the ash on a landfill. Higher pressure produces higher solids concentration in the filter cake, resulting in lower hauling costs. Also, since filter cake is scrutinized from the standpoint of leachate and groundwater contamination, it can be assumed that filter cake with higher solid concentrations will have less leachate. Another consideration is that higher pressure will increase the filter capacity, thus decreasing landfill costs. If the filter cake is to be incinerated, then the higher pressure will increase the solids concentration, causing the filter cake to burn more efficiently. A particular advantage of pressure filtration is the relatively clear filtrate that is produced. The suspended solids count is about twenty times less than the filtrate produced by vacuum filtration. Other process problems to be solved in a dewatering plant include pumping the viscous and abrasive sludge at a constant flow rate, which can be solved by using a mechanical feed pump with an equalizing tank, and constructing conveyors and operating valves at the correct time.

*Sludge, *Wastes, *Pressure, *Filtration, Waste treatment, Dewatering, Groundwater, Leachate, Cost analysis, Waste water treatment, Waste disposal, Suspended solids, Landfills, Separation techniques

Filter cakes, Filtrate, Waste sludge treatment, Pressure filtration, Vacuum filtration, Liquid-solid separation, High pressure filtration

D502
DRY SPREADER SOLVES SEWAGE TREATMENT PLANT PROBLEMS,

Public Works, Vol. 122, No. 11, p 55, November, 1975.

A dry sludge spreader has helped in minimizing sewage treatment plant problems at the Blucher Poole Treatment Plant in Bloomington, Indiana. Sludge handling during bad weather presented a real difficulty, particularly in winter months. A Big Wheels dry sludge unit was acquired by the plant and has made a significant difference in the amount of sludge that can be hauled away. From 1974 to 1975, the monthly number of dry pounds of solids to be removed from the plant increased from 5600 to 300,000. The treatment facility uses a complete mix modification of the activated sludge process and serves a population of 15,000 to 20,000. The sludge is basically domestic sewage sludge, with very little industrial waste and a low metals content. Although the sludge was highly desirable for area farmers, they would not accept sludge coming from dump trucks unless the ground was frozen or dry. Now, with the new spreader as a delivery method, sludge may easily be received from a belt loader and spread on cornfields and pastureland during all-weather conditions.

*Sludge treatment, *Sludge disposal, *Waste disposal, *Waste water treatment, Sewage sludge, Sewage treatment, Treatment facilities, Equipment, Dewatering, Activated sludge, Municipal wastes

Dry sludge spreader, Land application

D503
FROM LAGOONING TO FARMLAND APPLICATION: THE NEXT STEP IN LIME SLUDGE DISPOSAL,

Russell, G. A.

Northern Illinois Water Corporation,
Champaign.

American Water Works Association Journal, Vol. 67, No. 10, p 585-588, October, 1975. 4 fig, 3 tab.

The water-waste management program for the Champaign-Urbana community in Illinois is described. Because of the hardness of the water, lime-softening operations have been used since 1961 to reduce the hardness to 80 mg/liter. The lime-softening sludge had been deposited in lagoons, but as the population has increased, the original lagoons have been expanded. Presently, there is a lack of available land, and an alternative was sought to aid or eliminate the lagooning process. Recalcination and reuse was not an economically feasible alternative, and geographical limitations made discharge to a watercourse impractical. The solution found was that of application of naturally dewatered lime sludge to farmland. Because the soil of this area is acidic from nitrogen-ammonia fertilizer application, it is necessary to neutralize it periodically. A test performed on Champaign-Urbana lime sludge indicated that it was 94.9% effective as pure calcium carbonate. Handling the application of lime sludge may be achieved with a dry spreader, originally designed for waste water sludge disposal. Experiments with this spreader showed that naturally dewatered lime sludge may be hauled in bulk and stored near the field prior to application. The spreader may then be filled at the site, thus eliminating travel time between the lagoon and the field. The new technique will probably be implemented in the near future.

*Waste disposal, *Sludge disposal, *Water treatment, *Waste water treatment, *Economics, Dewatering, Agriculture, Lime, Lagoons, Recycling, Neutralization

Dry spreader, Land application

D504
STUDIES ON THE ADSORPTIVE EFFECT OF ACTIVATED CHARCOAL ON POLYCHLORINATED BIPHENYLS IN WATER (Yozon PCB no kaseitan kyuchaku shori ni kansuru kenkyu),

Kondo, M., Kishi, T., Shimamoto, T., Nishihara, T., and Watabe, K.

Osaka Daigaku Yakugaku Kiyo, Vol. 18, p 135-138, 1974. 7 fig, 5 ref.

The effectiveness of activated carbon adsorption of polychlorinated biphenyls (PCB) in water was investigated. PCB solution was mixed with activated carbon, and the adsorption rate of low chlorinated derivatives was found to be higher than that of high chlorinated derivatives. These results agreed with those of an activated carbon column method. Adsorption activity of the carbon was effected more by the diameter of the carbon particle than by the volume of carbon. The 70-145 mesh particles were the most effective.

*Water treatment, *Activated carbon, *Adsorption, *Polychlorinated biphenyls, Organic compounds, Laboratory tests, Mixing

D505
DEVELOPMENTS IN SEWAGE TREATMENT AT LEEDS,

Hudson, J. A., and Phillips, G. A.

Yorkshire Water Authority, Great Britain,
North Central Division.

Water Pollution Control, Vol. 74, No. 5, p 544-559, 1975. 9 fig, 10 tab, 6 ref.

The most recent developments in the modernization of Knostrop sewage works in Leeds, Great Britain, are detailed. The main objective was to build a plant capable of producing an effluent to meet River Authority standards. The plant in existence had been built 56 years ago and depended upon manual operation. Improvements (due to the high cost of labor) therefore, necessitated some degree of automation. In the past two years, an activated sludge plant, heat treatment plant, and incinerator have been put into operation. In addition, major changes have been made in the biological filters and obsolete pumping equipment has been replaced. New reconstruction has also begun of the high-level inlet works. The major problems encountered have been related to sludge treatment and disposal.

*Sewage treatment, *Waste water treatment, *Treatment facilities, Activated sludge, Biological treatment, Filtration, Filters, Pumping, Sludge treatment, Sludge disposal, Costs, Water quality standards

D506
INFLUENCE OF COLLOIDAL PARTICLES ON DEWATERING OF ACTIVATED SLUDGE WITH POLYELECTROLYTE,

Roberts, K., and Olsson, O.

The Swedish Institute for Surface Chemistry,
Stockholm.

Environmental Science and Technology, Vol. 9, No. 10, p 945-948, October, 1975.
5 fig, 21 ref.

Problems in finding the best polyelectrolyte and in controlling polyelectrolyte dosage under different operating conditions have occurred with sludges of biological origin. The dewatering of activated sludge samples with solids contents under 1% was studied using Capillary Suction Time techniques and a cationic polyelectrolyte for flocculation. It was found that the polyelectrolyte dosage for optimal dewatering was independent of the original solids content of the sludge. The dosage also corresponded to the amount of polyelectrolyte required to obtain a zero charge on the anionic colloidal particles in the sludge. It was further shown that the negative charge on the colloidal particle could be partially neutralized using a metal hydroxide rather than a cationic polyelectrolyte. This reduced the polyelectrolyte requirement for dewatering of the total sludge correspondingly. Dewatering of low-solids activated sludges from domestic sewage treatment plants with cationic polyelectrolyte can be determined largely by interactions between the cationic polyelectrolyte and the colloidal materials in the sludge. The mechanism of dewatering is probably a cross-linking of the added cationic polyelectrolyte with the natural anionic monomers and polymers in the sludge.

*Polyelectrolytes, *Dewatering, *Activated sludge, *Sewage treatment, Waste water treatment, Colloids, Cations, Polymers, Sludge, Flocculation

Capillary Suction Time

D507
CANADIAN WASTEWATER PLANT FEATURES MANY FIRSTS,

Public Works, Vol. 106, No. 11, p 58-59, November, 1975. 3 fig.

The secondary treatment phase of the waste water treatment facility for Hamilton, Ontario, was completed in 1974 at a cost over $25 million. Activated sludge treatment, pressure flotation for excess activated sludge thickening, additional digester, filter and boiler capacities, sludge incineration, standby power facilities, and landscaping were added in this phase. The plant includes many innovative design features such as four 83 inch diameter Archimedean pumps. Plant capacity is 60 million imperial gallons per day (migd), with some components having a hydraulic capacity of 120 migd for expansion. A 5,000 igpd pilot plant is used for studying the effects of biological treatment of industrial wastes discharged to the sewer systems, and for determining the effectiveness of nutrient removal processes. The chlorinated secondary effluent is discharged to the Hamilton Bay. Sludge is conditioned with polyelectrolytes, subjected to pressure flotation, digested, filter pressed, and then incinerated in one of two circular, mechanically rabbled, multiple hearth air cooled incinerators. Methane gas from the sludge digestion process is the main combustion fuel.

*Waste water treatment, *Activated sludge, *Treatment facilities, *Sewage treatment, Pilot plants, Biological treatment, Industrial wastes, Sludge treatment, Incineration, Waste water disposal, Sludge disposal, Methane

Hamilton (Ont)

D508
LOOP AERATION TANK DESIGN OFFERS PRACTICAL ADVANTAGES, PART I,

Jacobs, A.

Metcalf and Eddy, Incorporated, Palo Alto, California.

Water and Sewage Works, Vol. 122, No. 10, p 74-75, October, 1975. 2 fig, 6 ref.

The Carrousel aeration system (used in Europe since 1968) is a hydraulic variation of the activated sludge process that uses the hydraulic properties of a mechanical aerator to maintain adequate velocity and turbulence necessary for suspension of MLSS in deep channels with only a limited expenditure of energy. It combines plug flow and complete mix, and was developed as an economical alternative to the oxidation ditch. The Carrousel aeration tank is a mechanically aerated continuous channel. Oxygen is supplied to the mixture by a conventional vertical shaft, mechanical aerator at the influent end of the channel. The tank contents make one revolution through the channel every 10-30 minutes. An amount equal to the influent flow is constantly displaced over the effluent weir. The following steps must be followed in order to size the Carrousel system. The oxygen requirement and tank volume must be determined for a particular waste based on the food to mass (f/m) ratio, solids retention time, BOD, and flow. The type of mechanical aerator that can maintain the required channel velocities and oxygen content is chosen. The aeration tank aerator section and channel dimensions are then determined based on the aerator type selected. The channel depth is normally about 1.1 times the impeller diameter, while the channel width is about 2 times the channel depth. The channel length is determined based on the required volume, channel depth, and width. A computer program can then be used to optimize the dimensions for the particular aerator chosen and the tank volume.

*Activated sludge, *Aeration, *Treatment facilities, *Flow, *Waste water treatment, Mixing, Oxygen, Design criteria, Computers, Equipment

Carrousel aeration system, Aeration tanks

D509
LOOP AERATION TANK DESIGN OFFERS PRACTICAL ADVANTAGES, PART II,

Jacobs, A.

Metcalf and Eddy, Incorporated,
Palo Alto, California.

Water and Sewage Works, Vol. 122, No. 11, p 74-75, November, 1975. 4 fig, 2 tab, 6 ref.

The Carrousel aeration system has several advantages over conventional aeration tank configurations. The fact that the influent must make at least one loop through the tank before any portion of it can be discharged eliminates short-circuiting. Buffering capacities are provided that are similar to those afforded by complete mix designs. The relatively small number of aerators reduces the maintenance costs and capital costs. Not all the aerators must be operated to provide adequate channel velocities during low-flow periods which reduces electrical consumption. The Carrousel process requires less oxygen than complete mix processes at the same loading which achieves about a 10% power savings. The mechanical shaft, surface aerator used in current installations is economical, efficient, reliable and durable. Slow speed aerators are generally employed. The Carrousel system can combine nitrification and denitrification in one system. If the dissolved oxygen concentration in one of the channel reaches is maintained close to zero mg/liter, then denitrifiers present in this reach will become active and reduce the previously nitrified waste. Raw sewage is used as the carbon source for denitrification which eliminates the need for methanol addition. A 12 day sludge age is necessary to maintain the nitrifiers and denitrifiers in the system. As of September 1973, there were 19 Carrousel plants operating in the Netherlands, 19 operating in France, and another 67 either under construction or being designed. Some of the operating data for a plant in Lichtenvoorde, Netherlands, is graphically presented.

*Activated sludge, *Waste water treatment, *Aeration, Nitrification, Denitrification, Design, Treatment facilities

*Carrousel aeration system

D510
WASTEWATER TREATMENT WORLDWIDE,

Evans, R. W. G.

Australian Chemical Engineering, Vol. 16, No. 7, p 5-7, July, 1975.

A review of new waste water treatment technologies in various countries is presented. In Singapore, an island republic, a very sophisticated pilot plant for physico-chemical treatment has been designed which will treat raw sewage for direct reuse. The process includes lime treatment and ammonia stripping, filtration, carbon adsorption, demineralization, ozonization, and chlorination. In Great Britain, the trend has been to replace small treatment facilities with larger regional plants which serve more than 100,000 persons. Effluent from inland sewage treatment works is usually discharged to watercourses which supply water to downstream users. Thus, standards for nitrates, BOD, and suspended solids have become quite stringent. In the Ruhr area of Germany, rivers are managed on a catchment basis with dissolved oxygen being an important parameter. Sewerage systems in Switzerland are operated by municipalities; plants use either activated sludge, biological filtration or just primary screening and sedimentation. In Holland, sewage treatment standards are based on achieving dissolved oxygen in the effluent. Biological treatment with two stage high rate filters is common. In Australia, differing climatic, financial, legislative, and political conditions apply for the various parts of the country. The most frequently used methods of treatment include Imhoff tanks with low rate trickling filters, stabilization lagoons, separate sedimentation and sludge digestion with high rate filtration, and activated sludge plants.

*Waste water treatment, *Sewage treatment, *Reviews, *Equipment, Rivers, Effluents, Demineralization, Ozone, Chlorination, Activated sludge, Dissolved oxygen, Municipal wastes, Filtration, Biological treatment

Physico-chemical treatment

D511
EFFICACY OF BIOLOGICAL NITRIFICATION,

Sutton, P. M., Murphy, K. L., Jank, B. E., and Monaphan, B. A.

McMaster University,
Hamilton, Ontario, Canada,
Department of Chemical Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 11, p 2665-2673, November, 1975. 7 fig, 4 tab, 11 ref.

Pilot plant studies were performed on carbon removal and nitrification efficiencies obtained from three differently organized activated sludge treatment processes. These included single- and two-stage combined sludge systems and a two-stage separate sludge system. Nitrification, under a series of operating temperatures, and solids retention time (SRT) at pseudo steady-state conditions were compared. The effects on nitrification of ferric chloride and alum addition to a combined sludge nitrification system were recorded. SRT and temperature were the primary factors affecting performance. SRT levels were chosen on the basis of practical design considerations for full-scale facilities. Temperature levels represented values at which treatment plants can work in continental climates. Results indicate that, under pseudo steady-state conditions, separate and combined sludge systems remove equal amounts of filterable total nitrogen at equal system SRT's. Nitrification is independent of mixing and reactor ogranization in combined sludge systems. Nitrification rate is more sensitive to temperature than the rates for oganic removal; temperature sensitivity is reduced with increasing SRT in combined and separate systems; in a separate system, a minimum system SRT of 10 days is required in order to obtain complete nitrification at temperatures nearing 5 C. Adding inorganic chemicals to a nitrifying activated sludge plant at dosages that reach one mg per liter effluent total phosphorous concentrations does not seem to adversely affect nitrification rate.

*Waste water treatment, *Activated sludge, *Nitrification, Biological treatment, Pilot plants, Temperature, Nitrogen, Ammonia

Solids retention time, Alum

D512
PULSE TRANSFER GIVES THICKER SLUDGE,

Rosenquest, J. B., Jr.

Dorr-Oliver, Incorporated,
Stamford, Connecticut,
Environmental Applications.

Water and Wastes Engineering, Vol. 12, No. 10, p 37-39, October, 1975. 1 fig, 1 tab.

Pulse transfer for moving sludge has been used for more than 7 years at the Hatfield, Pennsylvania, sewage treatment plant and in a series of tests at the Salisbury, Maryland, treatment facility. In pulse transfer, sludge is moved by a diaphragm pump with short intermittent pumping cycles. A spring or vacuum assist has been added to the pump design to provide the pulsing characteristics necessary for moving sludge. Two No. 4 ODS pumps are used at the Hatfield facility to move a combination of primary, secondary, activated, and chemical sludges through an eight inch diameter line. Although the average velocity in the pipe is only one and three-eighths inches, the pulse peak velocity of three feet per second maintains the settleable solids in suspension. The diaphragm pumps have required little maintenance; the diaphragms have been replaced only once in 7 years. The tests conducted at the Salisbury plant determined the effect of pulse transfer on sludge consistency. No dilution occurred if the sludge was allowed to compact in the hopper. Two-minute pulses aided compaction. However, continuous operation reduced the solids content by causing unsettled solids to be drawn off from the upper, less dense portion of the sludge blanket. The beneficial effects of denser sludges include: a reduction in gallons pumped for a given quantity of suspended solids; lower fuel costs for incineration; and, more efficient dewatering filter operation. Pulse transferring removes the thickest available sludge from the hopper as it forms. The withdrawal rate matches the settling rate in the hopper. The density of the sludge can be controlled by manual or automatic means.

*Pumping, *Pumps, Sludge treatment, Waste water treatment, Hydraulics, Dewatering

D513
NEW PLANT CUTS PHOSPHATES,

Water and Wastes Engineering, Vol. 12, No. 10, p 49, October, 1975.

A new regional waste water treatment plant has been built by Lower Allen Township, near Harrisburg, Pennsylvania, to replace the original one mgd primary plant built in 1957. Upper Allen Township and the State Correctional Institution at Camp Hill will also share in the cost and use of the facilities. The waste water is pumped through a distribution chamber to primary clarifiers which provide both gravity and chemical treatment. Pebbled lime is fed into the clarifiers to remove the phosphorus. Secondary treatment is performed in four aeration tanks; further settling and clarification occur in two final clarifiers. Final treatment is chlorination after which the treated water is released into the Susquehanna River. Sludge is treated in a four step process comprising: degritting by a cyclone process; dewatering in one of two sludge thickeners; further dewatering in one of two centrifuges; and, incineration in an oil-fired seven level furnace. The process removes 80% of the phosphorus and 85% of the BOD.

*Waste water treatment, *Sewage treatment, *Treatment facilities, *Sludge treatment, Sludge disposal, Incineration, Dewatering, Centrifuges, Chlorination, Nutrient removal, Phosphorus, Biochemical oxygen demand, Regional planning

Lower Allen Township (Pa)

D514
GET THE MOST FROM THE FINAL CLARIFIERS,

Boyle, W. H.

Envirex Incorporated,
Waukesha, Wisconsin.

Water and Wastes Engineering, Vol. 12, No. 10, p 53-55, 82, October, 1975. 4 fig.

The final clarifier performs one of the most important unit functions in the activated sludge process. The hydraulic removal mechanism, sometimes called a vacuum or suction type device, is the preferred sludge collection mechanism when dealing with a light flocculant sludge. A brief review is presented of the main requirements for a hydraulic removal mechanism which are rapid sludge removal, minimum sludge agitation, maximum solids concentration, flexibility, and balanced hydraulic design. One of the two main types of circular hydraulic removal mechanisms is a rectangular tapered header made of 0.25 inch steel plate with orifices drilled into the header for the removal of sludge (the header design). The other device incorporates several withdrawal pipes with the sludge channeled by deflector plates to these pipes and transported to collection wells (riser pipe design). The hydraulic design of each of these devices is explained. The choice of hydraulic sludge removal mechanism should be based on performance, how the device affects the main process requirements, and an economic evaluation of capital and operational/maintenance expenditures.

*Waste water treatment, *Activated sludge, Hydraulic machinery, Hydraulics, Sludge, Design

Clarifiers, Hydraulic removal mechanisms, Sludge return

D515
OZONE DISINFECTION PILOT PLANT STUDIES AT LACONIA, NEW HAMPSHIRE,

Morin, R. A., Keller, J. W., Schaffernoth, T. J., and Paquette, D. R.

Laconia Water Works,
New Hampshire.

Journal of the New England Water Works Association, Vol. 89, No. 3, p 206-224, September, 1975. 1 fig, 7 tab.

A treatment system using activated carbon adsorption and ozone to effect virus inactivation was tested for the water supply of Laconia, New Hampshire. Pilot plant studies were conducted to substantiate the effectiveness of ozone as a viricidal agent and to establish the required dosage and contact time. A cost analysis for a proposed Ozone-Activated Carbon plant was also performed. Based on the pilot plant experiments, an ozone dosage of 1.0 to 1.25 ppm would provide adequate viral and bacterial disinfection of the relatively clean lake water. The construction and annual operating costs of the treatment scheme, including pre-chlorination at 1.5 ppm, activated carbon filtration and adsorption, disinfection with 1.20 to 1.50 ppm ozone and post-chlorination at 0.2 ppm were determined.

*Ozone, *Disinfection, *Viruses, *Water treatment, *Activated carbon, *Pilot plants, Treatment facilities, New Hampshire, Water supply, Lakes, Operating costs, Capital costs, Filtration, Adsorption, Chlorination

D516
TUBE-SETTLERS: THEORY AND PRACTICE,

Singh, R. C.

Indian Institute of Technology,
New Delhi, India,
Department of Civil Engineering.

Indian Journal Environmental Health, Vol. 17, No. 2, p 152-163, April, 1975. 4 fig, 2 tab, 7 ref.

Design criteria for sedimentation basins using tube-clarifiers are presented, based on work done in India. Two cases were detailed using rectangular and circular sedimentation tanks. The surface area loading rate is the most important design criterion for such tanks. The angle of inclination for the tube settlers was discussed. Plastic tubes with light weight and long life-spans, manufactured as a "tube-module" have provided for simple and inexpensive installation. It was found possible to increase the capacity of existing rectangular clarifier tanks by 100 to 200% and that of circular tanks by up to 100%. When these are used in conjunction with mixed-media filters, the capacity of an existing waterworks can be tripled without additional facilities construction. The importance of design techniques for newly developing nations was emphasized.

*Sedimentation, *Design criteria, *Filters, Water treatment, Water demand, Water resources development, Settling basins

Tube settlers

D517
INFLUENCE OF TREATED MUNICIPAL WASTE WATER ON GROWTH, FIBER, ACID-SOLUBLE NUCLEOTIDES, PROTEIN, AND AMINO ACID CONTENT IN WHEAT GRAIN,

Day, A. D., Taher, F. A., and Katterman, F. R. H.

Arizona University, Tucson,
College of Agriculture,
Department of Agronomy and Plant Genetics.

Journal of Environmental Quality, Vol. 4, No. 2, p 167-169, April-June, 1975.
2 tab, 12 ref.

Experiments were performed to study the effects of treated municipal waste water and well irrigation water plus commercial inorganic fertilizer on the growth, fiber, acid-soluble nucleotides, protein, and amino acid content in wheat grain (Triticum aestivum). The wheat was grown in Comoro sandy loam or Grabe silt loam. Irrigation schemes included: treatment with well water plus suggested amounts of nitrogen (112 kg/ha), phosphorus (35 kg/ha), and potassium (one kg/na); well water plus N, P, and K from commercial sources in amount equal to those found in waste water; and, waste water from an activated sludge sewage plant containing 224, 73, and 140 kg/ha of N, P, and K, respectively. The average number of heads per unit area and grain yield were higher in plots that received waste water. Average days from planting to maturity, plant height, seeds per head, and seed weight were similar for all three irrigation schemes. Grain from the plants irrigated with waste water contained more total protein, and more alanine, histidine, isoleucine, and proline than did grain produced with well water plus suggested N, P, and K or with well water plus N, P, and K in amounts equal to waste water. Similar amounts of cystine, methionine, and threonine were obtained from grains grown under the three irrigation schemes. Treated municipal waste water is an effective source of irrigation water and plant nutrients for the production of higher quality grain from small grains grown in Comoro sandy loam soil.

*Waste water disposal, *Irrigation, Crops, Crop response, Nutrients, Fertilizers, Nitrogen, Phosphorus, Potassium, Agriculture, Activated sludge

D518
OXYGEN TRANSFER EFFICIENCY IN DEEP TANKS,

Schmit, F. L., and Redmon, D. T.

SANITAIRE Water Pollution Control Corporation,
Milwaukee, Wisconsin.

Journal Water Pollution Control Federation, Vol. 47, No. 11, p 2586-2598, November, 1975. 8 fig, 2 tab, 15 ref.

An investigation was conducted to determine the relationship of oxygen transfer efficiency and power and air requirements to submergence in coarse bubble, wide band aeration systems. Methods used to measure oxygen transfer were also examined. The tests were conducted in a tank that was 34.33 ft wide X 6 ft long X 24 ft deep. Water depths up to 23 ft were used. The aeration system was a rotary positive blower driven by a 20 hp electric motor through a V-belt drive. The value of the dissolved oxygen saturation value (C(sat)) used in determining the mass transfer coefficient and the respective oxygen absorption had a significant effect on the results obtained. Determining C(sat) by obtaining the equilibrium or asymptotic DP value under test conditions was a reliable and reproducible method. The relationship of percentage oxygen absorption to submergence varied between the 0.76 and 1.08 power of submergence depending on whether air per unit volume or total air applied was held constant with varying water depths. When the water depth and submergence were fixed, an increased air rate resulted in an increase in percentage oxygen absorption and transfer capability. The advantages of deep tank construction, such as reduced area requirements and less air compressing and distribution equipment, may be obtained with a decrease in the power necessary to transfer the required oxygen. An economic evaluation of aeration tanks deeper than 15 ft should be included in the design stages of a facility as well as a consideration of the performance under peak demand conditions.

*Waste water treatment, *Aeration, *Treatment facilities, *Oxygenation, Design criteria, Oxygen requirements

D519
HIGHER SPEED MAY LOWER PROBLEMS,

Houck, D. H., and Weis, R. J.

Versar, Incorporated,
Springfield, Virginia.

Water and Wastes Engineering, Vol. 12, No. 10, p 32-34, October, 1975. 4 fig, 2 tab.

With proper understanding of the mechanics involved and suitable engineering for each installation, high speed aerators can be an economical solution to waste water treatment problems. The direct drive high speed aerator is essentially an axial flow pump with a 360 degree discharge. This aerator offers substantial improvement in design simplicity and ease of application over previous gear driven aeration units, resulting in relatively low capital and maintenance costs. Mixing and oxygen transfer efficiency are a function of proper design. The oxygen transfer and mixing are accomplished by raising the pumped liquid to a relatively high kinetic energy state and then impinging it on the surface of the basin at a sufficiently flat angle so that the energy is efficiently transferred to the body of liquid surrounding the unit. Particularly significant internal pump design characteristics include inlet and exit hydraulic configuration, impeller design, and operating speed. All other things being equal, the aerator which uses a lower speed motor, larger discharge volute diameter, and the greater number of blades on the impeller will have a higher capacity and be more efficient. In addition to good mechanical and hydraulic design, the unit must be applied in such a manner as to maximize its performance in a given waste treatment system. Examples of a proper design configurations are given. Baffles may be installed to assist the mixing in completely mixed reactive vessels.

*Aeration, *Equipment, *Mixing, *Mechanical engineering, Waste water treatment, Oxygenation, Mechanical equipment, Baffles, Impellers

High-speed aerators

D520
CURRENT TRENDS IN PACKAGED WASTEWATER TREATMENT FACILITIES, PART III,

Dresnack, R., and Miller, W.

Water and Sewage Works, Vol. 122, No. 10, p 98-101, October, 1975. 4 fig.

As the third part of a series on packaged waste water treatment, this paper discussed process variations, performance data, and selection criteria. A unit was designed by Zurn Industries, Incorporated, for physico-chemical treatment using activated carbon and alum coagulation combined with chlorination and sand filtration. A flow diagram and layout plan for this process was illustrated. A flow diagram for a chemical-biological treatment plant designed by Environment/One Corporation was also provided. The second plant operated on a modified batch process whereby waste water is accumulated and continuously aerated until a complete tank has been accumulated. The fresh water is then diverted out of the reactor vessel and the vessel becomes a sedimentation basin where organic polymer is added. Rapid sedimentation occurs as a product of biological stabilization, chemical flocculation, and quiescent settling conditions. Additionally, operational problems in package plants were outlined. These included mud (due to storm flow), noise from blowers or motors, scum formation when too much air is being used, and odors. Performance data were presented for a Tex-A-Robic extended aeration package treatment plant in Watchung, New Jersey, including yearly fluctuation of BOD and suspended solids. It was found that although effluent quality was better than it had formerly been with septic tanks, better operation, maintenance, and monitoring of equipment and flow would produce a cleaner effluent.

*Activated carbon, *Coagulation, *Biological treatment, *Waste water treatment, *Sewage treatment, *Treatment facilities, Operation, Maintenance, Design criteria, Biochemical oxygen demand, Suspended solids, Monitoring, Equipment

Physico-chemical treatment, Chemical-biological treatment, Chemical treatment, Package plants

D521
THICKENING OF COAGULANT AIDED PRIMARY WASTEWATER SLUDGES,

Oliver, J. W.

Virginia Polytechnic Institute and State University,
Blacksburg.

Dissertation Abstracts International B., Vol. 36, No. 4, p 1887-1888, October, 1975.

Research was conducted on the design of gravity thickeners for coagulant aided primary sludges. Laboratory tests were performed using solids flux analysis and the Yoshioka graphical solution. Results indicated that an impact on the settling velocity and limiting solids flux were produced by column diameter, initial sludge height, initial solids concentration, slow stirring, aging and shearing, and sludge type. The major laboratory system variables were evaluated separately for each sludge type. Settling velocity data for all sludges followed a power function relationship, with a bottom filling procedure being the most effective in assuring a completely uniform initial solids concentration. All the coagulant aided primary sludges were determined to be compressible and non-ideal in nature. It was recommended that full-scale thickener operation tests be conducted for comparison with these laboratory results.

*Sludge treatment, *Laboratory tests, *Analytical techniques, Sedimentation, Sludge disposal, Coagulation, Research

Gravity thickening, Solids flux analysis

D522
ROTATING BIOLOGICAL REACTORS REMOVE NUTRIENTS, PART I,

Hao, O., and Hendricks, G. F.

Water and Sewage Works, Vol. 122, No. 10, p 70-73, October, 1975. 3 fig, 3 tab.

A pilot plant study conducted at the Columbus, Indiana, sewage treatment plant, demonstrated that rotating biological reactors can efficiently remove BOD, suspended solids (SS), and ammonia nitrogen from waste water. A full-scale plant was designed based on the results of this pilot study. The pilot bio-disc unit consisted of a 24-in module containing 36 bio-discs with a total media surface area of 250 sq ft arranged in four stages. The results of the pilot test are presented. BOD removal, generally effective and improved by chemical addition, was adversely affected by direct chemical addition on the bio-disc fourth stage tank, waste activated sludge from the primary clarifiers, and rotating speeds greater than 8 rpm. The BOD removal efficiencies were independent of the influent BOD concentration. Suspended solids were removed effectively by the system when ferric chloride was added. Suspended solids removal was affected by the same factors as BOD removal.

*Waste water treatment, *Pilot plants, Biological treatment, Biochemical oxygen demand, Suspended solids, Treatment facilities

Biological rotating discs

D523
ROTATING BIOLOGICAL REACTORS REMOVE NUTRIENTS, PART II,

Hao, O., and Hendricks, C. F.

Water and Sewage Works, Vol. 122, No. 11, p 48-50, November, 1975. 7 fig, 2 ref.

A pilot plant study conducted at the Columbus, Indiana, sewage treatment plant demonstrated that rotating biological reactors can efficiently remove BOD, suspended solids (SS), and ammonia nitrogen from waste water. A full-scale plant was designed based on the results of the pilot study. BOD, SS, ammonia nitrogen, and phosphate removals with the addition of alum or ferric chloride were examined. Phosphate removal increased by adding alum directly to the fourth stage of the rotating disc; however, this adversely affected BOD and SS removals. The selected alum concentration was 100 mg/liter; optimum polymer dosage to complement this alum dosage was 0.25 to 0.75 mg/liter. Total nitrogen removal could not be balanced due to the lack of Kjeldahl nitrogen analysis. Therefore, the extent of nitrification and denitrification could not be determined. The ammonia nitrogen removal results were excellent.

*Waste water treatment, *Pilot plants, Phosphorus, Nitrogen, Ammonia, Nutrient removal, Treatment facilities, Nitrification, Denitrification, Sewage treatment

Rotating biological discs

D524
REVERSE OSMOSIS OF TREATED AND UNTREATED SECONDARY SEWAGE EFFLUENT; APPENDIX A-2 AND APPENDIX A-6,

Boen, D. F., and Johannsen, G. L.

Eastern Municipal Water District,
Hemet, California.

January, 1975. 2 append. PB 239 354.

This volume was published to complete the report, "Reverse Osmosis of Treated and Untreated Secondary Sewage Effluent," EPA-670/2-74-077. Appendix A-2 consists of pH's R.O. Units Feed, and lists data by project week and day. Appendix A-6 is a computer printout summary for monthly statistics from reverse osmosis tests. These data correspond to six commercially designed reverse osmosis pilot units from Universal, Raypak, Gulf, Du Pont, American Standard, and Aerojet.

*Reverse osmosis, *Pilot plants, *Data collections, *Statistical analysis, *Sewage effluents, Sewage treatment, Waste water treatment

Appendices

D525
ONSHORE TREATMENT SYSTEM FOR SEWAGE FROM WATERCRAFT RETENTION SYSTEMS,

Glueckert, A. J., and Saigh, P. A.

General American Transportation Corporation,
Niles, Illinois,
General American Research Division.

March, 1975. 38 p, 8 fig, 9 tab, 24 ref. PB 239 630.

Sanitary wastes collected from watercraft at marina pumpout stations often contain high concentrations of chemical additives and are generally more concentrated than typical wastes entering municipal sewer systems. In order to treat these wastes, the General American Research Division of the General American Transportation Corporation has developed an Evaporative Toilet System (ETS) for the collection and treatment of such raw sewage. An evaporative waste system was tested by operating a propane-fired evaporator for 224 hours with in-house sewer wastes and wastes collected from marina holding tanks. The system treated 1,212 gal of sewage and concentrated the total solids of sludge from 0.5% to 12.4%. Concentrated sludge was then incinerated in a batch-type incinerator. It was demonstrated that this method is applicable as an alternative to hauling watercraft wastes to sewers or other disposal sites. The chemical additives had no deleterious effects on the evaporator. The evaporator required about one million kilocalories per 1000 liters of waste water evaporated; costs depended upon the price of the fuel used.

*Waste water treatment, *Incineration, *Evaporation, *Sewage treatment, Costs, Energy, Domestic wastes

Evaporative waste system, Watercraft sewage

D526
UPGRADING WASTEWATER STABILIZATION PONDS TO MEET NEW DISCHARGE STANDARDS,

Utah State University,
Logan.

March, 1975. 243 p. Edited by E. J. Middlebrooks, D. H. Falkenborg, R. F. Lewis, and D. J. Ehreth. PB 240 402.

A collection of papers has been published on the question of whether lagoons meet the new secondary treatment standards and what method would be most appropriate to upgrade lagoon treatment in cases where they do not meet standards. A symposium was held for Environmental Protection Agency staff and state officials to review the program of the Office of Research and Development for upgrading lagoons. Papers included in this volume discuss the basic biology of the treatment mechanisms, disinfection technology, and controlled discharge operations. Included also are cost effective analyses and new fields of related research. It has been demonstrated that intermittent sand filtration, submerged rock filtration, and land application of sewage effluents are effective alternatives to removing algae from sewage lagoons.

*Lagoons, *Sewage treatment, *Effluents, *Water quality standards, Environmental effects, Waste water treatment, Costs, Filtration, Sewage effluents, Waste disposal, Publications

Land application, Lagoon upgrading

D527
A MANUAL FOR THE EVALUATION OF A STATE DRINKING WATER SUPPLY PROGRAM,

EPA-430/9-74-009, December, 1974. 49 p, 6 tab, 13 ref, 3 append.

This manual was written to serve as a guide for EPA regional personnel in evaluating State water supply programs, as a guide for States in evaluating their own programs, and, to provide sufficient criteria, standards, and guidelines for the development of a model State water supply program that will effectively regulate and insure a healthful and safe supply of drinking water to the public. The first section of the manual discusses the three major divisions of authority under which a State water supply program normally operates. These include legal statutes, administrative rules and regulations, and water supply program policy. The second section lists the activities which are necessary for an effective regulatory and surveillance program. This section also presents guidelines for competent and efficient performance of these activities. The third section provides guidelines for the evaluation of a State's drinking water supplies and discusses criteria for selecting a representative number of public water supplies for study, current assessment of water supply systems based on a field survey of existing conditions and/or examination of pertinent data recorded in State, county, or water utility files, and important sanitary features of a water supply system and their health significance.

*Water supply, *Water quality control, *Water sources, *Potable water, Public health, Standards, Monitoring

Water supply program evaluation

D528
FLUORIDATION ENGINEERING MANUAL,

Bellack, E.

Environmental Protection Agency, Washington, D. C.,
Office of Water and Hazardous Materials,
Water Supply Division.

EPA-520/9-74-022, 1974. 94 p, 19 fig, 6 tab, 55 ref, 1 append.

This manual on fluoridation engineering is designed to assist local and state engineers in designing fluoridation installations and water plant personnel in operating them. Emphasis is placed on the fact that the optimum concentrations have been determined by many studies involving millions of people, and should be adhered to. A deficiency of fluorine can lead to tooth decay, while an excess is the cause of dental fluorosis. The manual covers the following topics: compounds used in controlled fluoridation; feeders used for adding fluorides; preparation of fluoride solutions; selecting the optimal fluoridation system; control and surveillance; maintenance; safety and hazards in handling fluoride chemicals; and, technical problems attributed to fluoridation. No matter how well a fluoridation installation is designed, it is the water plant personnel who insure the successful operation. When planning a fluoridation installation, quantity of water pumped, economy, convenience, and location will affect the choice of chemical and equipment.

*Water treatment, *Potable water, *Water works, *Fluoridation, Public health, Personnel, Design criteria, Treatment facilities, Equipment, Fluorides

D529
LAND AND SEA SOLIDS MANAGEMENT ALTERNATIVES IN PHILADELPHIA,

Guarino, C. F., Nelson, M. D., Townsend, S. A., Wilson, T. E., and Ballotti, E. F.

Philadelphia Water Department,
Philadelphia, Pennsylvania.

Journal Water Pollution Control Federation, Vol. 47, No. 11, p 2551-2564, November, 1975. 7 fig, 9 tab.

A study was performed for the city of Philadelphia, Pennsylvania, comparing land application with ocean disposal of waste water solids. Since May 1973, Philadelphia has disposed of its digested sludge at a sea dispersal site 50 nautical miles from the mouth of the Delaware River. The city's three waste water treatment facilities handle a total of 447 mgd. Alternatives for solids disposal were detailed. Sea disposal methods included: dispersing thickened digested solids 11.5 nautical miles from Cape May, New Jersey (practiced from May 1961 until May 1973 when the EPA moved the site); dispersing unthickened digested solids at that location; or dispersing unthickened digested solids at a point 50 nautical miles from Cape May. Land application alternatives were: dispersing liquid sludge by sprinkler irrigation, plow-in technique or tanker application; dispersing sludge cake by trenching, land filling or spreading and incorporating; or by composting. After considerations of costs, environmental effects, and operational simplicity, it was concluded that ocean dispersal should be continued for solids management in Philadelphia.

*Waste disposal, *Sludge disposal, *Waste water treatment, Pennsylvania, Costs, Oceans, Delaware River, Irrigation, Environmental effects, Solid wastes

*Land application, Ocean dispersal

D530
FERRIC CHLORIDE AND ORGANIC POLYELECTROLYTES FOR THE REMOVAL OF PHOSPHORUS,

Green, O., VanDam, D., LaBeau, B., Campbell, T., and Daniels, S. L.

Wastewater Treatment Plant,
City of Grand Rapids,
Grand Rapids, Michigan.

February, 1974. 12 fig, 21 tab, 40 ref, 3 append. PB 239 866.

A total phosphorus content of 1.0 mg/liter or less was obtained in the final effluent of a 44 mgd activated sludge plant at Grand Rapids, Michigan. This municipal waste water treatment facility consisted of chemical precipitation and flocculation systems of ferric chloride and an organic polymeric flocculant. Split addition of chemicals was practiced, with ferric chloride added to both the primary and secondary systems and flocculant added only to the secondary system. The performance and economic improvements obtained in other unit processes were also demonstrated. During normal flow these included: reduced organic loading to the activated sludge process, reduced BOD and suspended solids in the final effluent, additional heavy metals removal, and improved solids handling and disposal up to the limits of capacity.

*Nutrient removal, *Phosphorus, *Waste water treatment, *Activated sludge, *Chemical precipitation, Flocculation, Treatment facilities, Polymers, Economics, Biochemical oxygen demand, Suspended solids, Heavy metals

Ferric chloride, Organic polyelectrolytes

D531
THE INVESTIGATION OF ION REMOVAL FROM WATER AND WASTEWATER,

Starkey, R. J., Jr., Kub, M. E., Binks, A. E., and
Jain, K. K.

General Electric Company,
Philadelphia, Pennsylvania,
Re-entry and Environmental Systems Division.

August, 1973. 38 fig, 19 tab, 14 ref, 6 append. PB 240 158.

Capillary membrane dialysis, alumina adsorption, and alum/polyelectrolyte coagulation techniques were evaluated under laboratory conditions to determine their relative effectiveness in removing nutrients, cations, and anions from freshly collected samples of stream water and waste water effluents. Of these, alumina adsorption was highly effective in the removal of phosphorus, inorganic carbon, and most cations, and reduced specific conductance and hardness. High Kjeldahl and ammonia nitrogen removal efficiencies of alumina were observed only in samples of waste water where pre-treatment concentrations were relatively high. With alumina treatment, however, dissolved solids contents and pH increased. Dialysis was less effective than alumina adsorption regarding cation removal, but produced equivalent results with respect to inorganic carbon. Organic carbon concentrations were not significantly reduced, due to the association with macromolecules having a molecular weight greater than 5000. Dialysis was superior in the removal of sodium, potassium, chloride, nitrate-nitrite, boron, and dissolved solids. Coagulation was effective in removing phosphorus from all waters but was highly ineffective in respect to all the other parameters.

*Waste water treatment, Coagulation, Phosphorus, Nutrient removal, Cations, Anions, Polyelectrolytes, Water treatment, Adsorption, Dialysis, Organic compounds

Ion removal

D532
EVALUATION OF WASTEWATER TREATMENT PLANTS AT HENDERSON, NEVADA,

May, 1973. 16 p, 2 fig, 1 tab. PB 240 253.

A descriptive evaluation is presented of the two waste water treatment facilities owned by the City of Henderson, Nevada. The operation and maintenance of each plant was surveyed and waste water samples were collected in an effort to locate point sources of high salinity effluents. It was found that the Henderson Wastewater Treatment Plant No. 1, built in 1957, is operated and maintained in an acceptable condition. The plant uses two Imhoff tanks and two oxidation ponds in series and operates within the expected range of removal rates. However, the Henderson Wastewater Treatment Plant No. 2, built in 1943, was found to have deteriorated to an unacceptable condition. The two-stage trickling filter plant was designed for both industrial and municipal wastes. While the city is attempting to restore the plant to operable conditions, the many years of operation without proper maintenance have caused most of the units, piping, and pumps to need major repairs. Such repairs will be costly in both materials and manpower.

*Waste water treatment, *Treatment facilities, Nevada, Monitoring, Municipal wastes, Operation, Maintenance, Effluents, Filtration, Biological treatment

Imhoff tanks

D533
DENITRIFICATION METHOD BY BIOLOGICAL METHOD: RELATIONS BETWEEN DENITRIFICATION AND BOD5 (Seibutsugaku teki hoho ni yoru datsu-chisso-ho: datsuchitsu to BOD5 no kankei),

Mikami, E.

Kankyo Sozo, Vol. 5, No. 7, p 41-45, July, 1975. 2 fig, 8 tab, 7 ref.

Biological treatment in the denitrification of waste water is discussed. The biological denitrification process involves two steps--oxidation-nitrification and denitrification. Microorganisms used in the former step are aerobic microorganisms, while those in the latter are anaerobic. The function in the first step is to oxidize the BOD to ammonium ion, and then further to nitrogen dioxide or nitrate. The second process reduces the inorganic nitrogen compounds to nitrogen gas. With the use of individual oxidation and nitrification steps, it was found that 97% denitrification could be achieved for the waste water containing both high BOD and nitrogen compounds.

*Biochemical oxygen demand, *Nitrification, *Denitrification, Biological treatment, Microorganisms, Anaerobic treatment, Aerobic treatment, Waste water treatment, Oxidation

D534
HYDROGEN PEROXIDE FOR WASTEWATER TREATMENT,

Kibbel, W. H., Jr.

Public Works, Vol. 107, No. 1, p 60-62, January, 1976. 1 fig, 1 tab.

An increased usage of hydrogen peroxide in municipal waste water treatment has been noted. While the primary function of H_2O_2 is the removal of sulfide-caused odors, it also controls sludge bulking in activated sludge systems. When added to collection mains upstream from a treatment plant, hydrogen peroxide has provided additional dissolved oxygen to the plant influent and has improved plant efficiency in the removal of suspended solids and BOD. The physical and chemical properties of hydrogen peroxide are detailed and safety precautions for its handling are provided. Hydrogen peroxide is stable when stored properly, but contaminants, such as heavy metals and their salts, must be kept from entering storage containers and tanks and thus increasing the decomposition rate. Shipping equipment for H_2O_2 includes tank trucks, drums, and tank cars. Storage should be only in the original container and adequate ventilation and ample water for washing in the cases of accidental spillage should be provided.

*Waste water treatment, Activated sludge, Odor, Biochemical oxygen demand, Suspended solids, Tanks, Safety, Chemicals, Transportation, Physical properties, Chemical properties

*Hydrogen peroxide

D535
BLOOMINGTON GOES SOLID-STATE,

Anderson, E. H.

Orr-Schelen-Mayeron & Associates,
Minneapolis, Minnesota.

Water and Wastes Engineering, Vol. 12, No. 11, p 64-66, November, 1975. 2 fig.

An automatic control system for the Bloomington, Minnesota, water treatment plant is described. Designed in 1972, the facility is equipped with a solid-state electronic control panel with three merchandized graphics to control storage reservoir levels, water distribution system pressures, remote pumping stations and local deep wells. In addition to these functions, the control system monitors the city's 16 sanitary sewers and 3 storm sewer lift stations. Warnings are provided for high wet and dry wells, power failures, transmission line failures, and vandalism. The facility is close to a residential area and noise levels outside the building have been kept quite low with the elimination of air compressors to produce carbon dioxide and with the installation of sound-absorbent materials around pumping areas.

*Automation, *Control systems, *Waste water treatment, *Sewers, Water treatment, Computers, Treatment facilities, Construction, Equipment, Design criteria

D536
STUDY OF THE REMOVAL OF PHOSPHATE FROM WASTE WATER BY LIME (UNTERSUCHUNGEN ZUR ABWASSERENTPHOSPHATUNG DURCH EINSATZ VON KALK),

Klages, F. W., and Meyer, B.

Gas-und Wasserfach-Wasser/Abwasser, Vol. 116, No. 8, p 370-372, August, 1975. 1 fig, 1 tab, 2 ref.

Experiments on the preliminary removal of phosphates from the waste water of a municipal treatment plant are described. Residual phosphorus levels of 0.7-0.8 mg/liter could be achieved by adding slaked lime to reach pH values between 9.6 and 10. The slaked lime dose ranged from 125 to 210 g/liter. As a result of the slaked lime treatment, the volume of the sewage sludge decreased. Dry matter contents ranged from 8 to 14%, and good settling and dehydration of the sludge was achieved without additional conditioning. It was also possible to reduce the residual phosphorus content in the waste water to 0.25 mg/liter by coprecipitation with slaked lime and ferric oxide.

*Nutrient removal, *Phosphates, Waste water treatment, Treatment facilities, Lime, Sludge treatment, Biological treatment, Chemical precipitation, Municipal wastes

Phosphate removal, Ferric oxide

D537
EXPERIMENTAL STUDIES ON THE SEWAGE TERTIARY TREATMENT BY ROTATING DISC METHOD (Kaiten enbanho ni yoru gesui 3-ji shori no jikkenteki kenkyu),

Ishiguro, M., Watanabe, Y., and Masuda, S.

Preprint, Japan Society of Civil Engineers, Tokyo, p 528-529, 1975. 5 fig, 5 ref.

The tertiary treatment of sewage was studied using a rotating disc method. The facility consisted of four baths in series; each of these was equipped with several rotating discs 50 cm in diameter. The first three baths were for aerobic nitrification oxidation treatment and the fourth bath was for anaerobic denitrification treatment. The last bath was equipped with an apparatus to supply methanol. The rotating discs were operated at 5 to 10 rpm and the input of sewage water into the system was at the rate of one to 4.6 liters/min. Activated sludge treated water was used; parameters were: BOD, 22 to 60; COD, 10 to 50; TOC, 20 to 35; DO, 0 to 1.4; suspended solids (SS), 20 to 290; NH4-N, 20 to 110; T-N, 30 to 110; PO4, 0.8 to 10 mg/liter; pH, 6.8 to 7.5; turbidity, 18 to 250, and temperature, 15 to 30 C. The effluent from the third bath contained BOD, 5 to 10; COD, 5 to 10; SS 10; ABS 0.1 to 0.4; PO4, 0.6 to 6 mg/liter; and pH 6.7 to 7.0. The removal efficiency of BOD achieved by the first three baths was 85% and more than 90% for the 20 and 10 g/sq md loads, respectively.

*Tertiary treatment, *Sewage treatment, *Biological treatment, *Nitrification, *Oxidation, Anaerobic conditions, Aerobic conditions, Denitrification, Activated sludge, Biochemical oxygen demand, Organic compounds, Turbidity, Effluents

*Rotating disc method

D538
WASTEWATER TREATMENT PROCESS SENDS NUTRIENTS BACK TO THE LAND,

Engineering News-Record, Vol. 195, No. 22, p 18, November 27, 1975.

A 4.8 mgd advanced waste water treatment plant is under construction near North Lake Tahoe, California, and will be the first to include the ammonia removal and recovery process (ARRP). The process begins with a series of selective ion exchange beds that follow activated carbon treatment and includes closed-air towers and ducts in its stripping and absorption modules. As influent passes over 4-ft deep beds of clinoptilolite, the ammonium ions (concentrated at about 15 to 20 ppm) will be adsorbed. The remaining effluent will then pass through an 18-inch diameter pipe for chlorination and disposal. While all the waste water passes over the clinoptilolite, only the spent regenerant, enriched to an ammonium concentration of 300 ppm, is pumped to the stripping towers. There, sodium hydroxide converts the ammonium ions to ammonia gas, which is ducted to a smaller absorption tower and dissolved and concentrated. The liquid is pumped to storage tanks when the ammonium sulfate concentration reaches 40%. The solution leaving the absorption tower contains about 9% available nitrogen, suitable for direct irrigation by farmers or for blending by commercial fertilizer manufacturers.

*Waste water treatment, *Recycling, *Construction, *Tertiary treatment, Ammonia, Nitrogen, Absorption, Ion exchange, Irrigation

*Clinoptilolite, *Ammonia removal and recovery process (ARRP)

D539
CRITERIA FOR THE EVALUATION OF THE EFFICIENCY OF SECONDARY SETTLERS (Kriteiy otsenki raboty vtorichnykh otstoyhikov),

Zhukov, A. I., Skirkov, I. V., and Bondarev, A. A.

Vodosnabzhenie i Sanitaranaya Teknika, No. 7, p 4-5, 1975. 1 tab, 2 ref.

Experiments were conducted to determine criteria for the efficiency of secondary settling tanks. The sludge index and the activated sludge concentration in the aeration tank were identified as universal criteria of the efficiency of secondary settling tanks, regardless of the design and of the type of activated sludge. One may substantially increase the throughput capacity of a purification facility by increasing the activated sludge dose in the aeration basin to a limit at which the normal operation of the secondary settler still exists.

*Activated sludge, *Aeration, Waste water treatment, Treatment facilities, Equipment, Tanks, Sedimentation

D540
REMOVAL OF ORGANIC MATTER BY FLOC COLLOIDS ONTO SLUDGE PARTICLES,

Treanor, A. I.

Water Services, Vol. 79, No. 956, p 420-422, October, 1975. 4 fig.

Nearly all natural waters contain varying types and amounts of organic matter. Removal by the coagulation process depends on the nature of the organic substance, the mineral content of the water and the chemical characteristics of the coagulant. Organic substances found in water are either fulvic acid or humic acid materials. These generally have negative charges and in order for coagulation to take place, the charge must be reduced. This charge, or zeta potential, may be reduced by adding a mineral salt, such as aluminum sulfate, ferric sulfate, ferric chloride or chlorinated ferrous sulfate. After coagulation, flocculation, sedimentation or filtration may be necessary for removal of organic matter. Flocculation is accomplished by gentle agitation of the water so that the floc colloids can collide and aggregate into floc particles. There is a size limitation to this process, but after an aging process, causing contraction of the particles, increased density and resistance to shear, they are considered as sludge particles and can combine with unaged floc colloids. These then can grow to a large enough size so that sedimentation or filtration can take place. In this process it is important that just the right amount of coagulant be added so that aging does not take place too quickly and the design of the clarifier must be such that sludge particles combine only with unaged floc colloids. A polyelectrolyte can be employed to increase settling rate and plant throughput. This is used in the Permutit-Boby Precipitator. This addition simplifies the flocculation stage and the aging process and segregates sludge growth from the coagulation process.

*Organic matter, *Flocculation, *Sludge, Salts, Natural streams, Fulvic acids, Humic acids, Chemical precipitation, Sludge treatment, Sedimentation, Filtration, Polyelectrolytes, Colloids, Coagulation, Zeta potential

458

D541
TECHNIQUES FOR DISPERSING AND DISSOLVING OZONE IN WATER/ PART I,

Massachelein, W., Fransolet, G., and Genot, J.

Intercommunal Water Company,
Brussels, Belgium,
Laboratories CIBE.

Water and Sewage Works, Vol. 122, No. 12, p 57-60, December, 1975. 5 fig, 4 tab.

Selection of a contacting system for water injection of ozone was discussed. Experiments showed that treatment using circulating water was more efficient than a batch treatment technique. The rate of disinfection by ozone depends upon both the action of residual concentrations and on the action of contact between an "ozone bubble" and the microorganisms. Both effects should influence the choice of system. Ozone-bubble contact should be promoted by appropriate mixing conditions while gas stripping is to be avoided during a sufficient period of the quiescent action of residual ozone dissolved in the water. As Part I of a continuing article, this paper compared and evaluated several ozone-contacting systems, including hydrostatic injection with porous pipes, total injector, Vortex propeller, water recirculating propeller, air dispersing impeller, and liquid-circulating aeration impeller systems.

*Water treatment, *Ozone, Kinetics, Disinfection, Aeration, Microorganisms, Performance

Ozone residuals

D542
ECONOMIC SCRUBBERS FOR THE PROCESSING INDUSTRY,

Processing, Vol. 21, No. 11, p 12, November, 1975.

Ozone has been used rather than NaOH as the oxidant to reduce H2S emission levels in exhaust gas emissions from sewage and other waste treatment facilities. When ozone and sodium hypochlorite were compared, the operational costs for ozone treatment were found to be lower. Tests have been carried out in Great Britain for the Northumbrian Water Authority using NaOH plus ozone as the scrubbing medium. An inlet flow with a level of 0.33 ppm H2S was used; after a single stage scrubbing the level was reduced to below 0.001 ppm. Unlike sodium hypochlorite, ozone is generated on-site and the reaction results in no unwanted byproducts.

*Economics, *Odor, *Sewage treatment, *Oxidation, Waste water treatment, Operating costs, Hydrogen sulfide, Treatment facilities

Sodium hydroxide

D543
OVERVIEW OF SLUDGE HANDLING AND DISPOSAL,

Farrell, J. B.

U. S. Environmental Protection Agency, Cincinnati, Ohio,
Ultimate Disposal Section, Treatment Process Development
Branch, Advanced Waste Treatment Research Laboratory.

In: Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, May 21-22, 1974, New Brunswick, New Jersey, Rutgers University, p 1-22. 3 fig. 3 tab, 10 ref.

An overview of the sludge handling and disposal research performed by the Ultimate Disposal Section of the U. S. Environmental Protection Agency's National Environmental Research Center in Cincinatti, Ohio, is presented. An objective of this group has been to advance the technology for processing and disposing of the concentrates from municipal and advanced waste water treatment processes. Recent developments in treatment and disposal operations are considered. Before dewatering, sludges must be thickened as much as possible. Gravity and air flotation thickeners are most commonly used. Recent developments in stabilization processes include anaerobic or aerobic thermophilic digestion. These processes combine stabilization and pasteurization into one step and cost reductions can result. Filtration and centrifugation are the most commonly used methods of dewatering. Newer methods include filter presses, vertical presses and belt filters. These methods are good for making high cake solids. Before filtering, sludges must be conditioned. The most effective means besides additives is heat treatment. Sludge disposal is becoming the largest problem in waste water processing. Conventional methods include ocean disposal, landspreading, landfill and incineration. Ocean disposal and incineration do not face promising futures because of the other types of pollution they can cause; land application and landfill are subject to guidelines and available sites. Promising areas for the future include co-incineration and co-pyrolysis of sludge with solid waste.

*Sludge, *Sludge disposal, Waste water treatment, Dewatering, Municipal wastes, Filtration, Centrifugation, Heat treatment, Ultimate disposal, Oceans, Landfill, Incineration, Stabilization

Sludge conditioning, Ocean disposal, Co-incineration, Co-pyrolysis, Filter cake, Gravity thickening, Air flotation

D544
THERMAL DEGRADATION OF SLUDGES,

Olexsey, R. A.

U. S. Environmental Protection Agency, Cincinnati, Ohio,
Ultimate Disposal Section, Treatment Process and Development Branch,
Advanced Waste Treatment Research Laboratory.

In: Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, May 21-22, 1974, New Brunswick, New Jersey, Rutgers University, p 127-196. 16 fig, 8 tab, 69 ref.

Although land disposal of sewage sludge remains the most common method of application, there are increasing pressures to employ on-site reduction and disposal methods. Alternate techniques in the form of thermal processing or thermal degradation are discussed. Analysis of some sludge properties shows that sludge is mostly water, is inclined to retain the water, is difficult to handle and odorous, has 30% nonvolatile materials or solids, and is corrosive to equipment. Incineration, despite its drawbacks, is the most attractive alternative. Different types of incinerators are discussed. The multiple hearth sludge incinerator is the most popular in the United States. In the three operating zones the sludge is dried, burned and then cooled. Volume reduction in the 90% range is typical. The fluidized bed is the second most popular method in the United States. A bed of inert materials capable of oxidizing organic solids is used in this design. This method is simple to operate. Other less widely applied methods of incineration include the flash drier-incinerator, the rotary kiln, and the cyclone furnace. Three commodities go into a sludge disposal system: money, sludge and fuel. Two main products are ash and gas emissions. Incineration as compared to land application of sludge is costly, fuel consuming, and can contribute to air pollution. Other methods of on-site disposal are being investigated that will minimize these disadvantages, including pyrolysis, combined incineration with sludge waste, and wet oxidation.

460

*Heat, *Degradation (decomposition), *Sludge, *Sewage sludge, Sludge disposal

D545
THICKENING CHARACTERISTICS OF ALUMINUM AND IRON PRIMARY SEWAGE SLUDGES,

Hathaway, S. W., and Farrell, J. B.

U. S. Environmental Protection Agency, Cincinnati, Ohio, Ultimate Disposal Section, Treatment Process and Development Branch, Advanced Waste Treatment Research Laboratory.

In: Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, May 21-22, 1974, New Brunswick, New Jersey, Rutgers University, p 197-235. 6 fig, 10 tab, 7 ref.

Phosphate removal in sludge is usually accompanied by the precipitation of metallic salts such as aluminum and iron. Thickening characteristics of Al-primary and Fe-primary sludges by means of standard gravity thickening and air flotation measurements are defined. Since sludge characteristics change even within a certain treatment facility, duplicate treatment units were set up to standardize measurements. Sludges were treated with either alum or ferric chloride. These sludges were very homogeneous mixtures while the conventional primary sludge was fibrous and lumpy. Results showed that Al-primary and Fe-primary sludges do not gravity thicken as well as conventional primary sludges. They only thicken to about 4-5% solids. Dilution with effluent or polymer conditioning can greatly improve thickening rates. Air flotation has shown to be a satisfactory means of thickening Al and Fe-primary sludges but is not as effective with conventional primary sludge. Polymer addition improves performance. There is a need for a more comprehensive screening to uncover polymers that may produce higher solids contents at higher thickening rates. Al and Fe-primary sludges can be filtered at reasonable rates, as long as the solids content is above 4%. This solids content can be achieved by gravity or flotation thickening. Subsequent dewatering steps are thus practicable and capital costs for equipment are not excessive.

*Sewage sludge, *Aluminum, *Iron, Salts, Chemical precipitation, Sludge, Phosphates, Filtration, Gravity, Sludge treatment, Treatment facilities, Waste treatment, Economics, Dewatering, Equipment, Effluents, Polymers

*Thickening characteristics, Primary sewage sludges, Phosphate removal, Gravity thickening, Air flotation, Thickening rates, Alum, Polymer conditioning

D546
FUTURE PROBLEMS IN SLUDGE PRODUCTION AND HANDLING SYSTEMS,

Hunter, J. V.

In: Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, May 21-22, 1974, New Brunswick, New Jersey, Rutgers University, p 267-281. 11 ref.

Ferric salts, alum or lime can be used in waste water treatment in two ways: as a coagulant for the removal of particulate materials; or as a precipitant in phosphate removal processes. Inorganic compounds will result. Modifications and problems in present sludge treatment and handling processes that might be expected from their employment are indicated. The composition, production, water holding capacities, and digestion of the sludge and the regeneration and recovery of the precipitants and coagulants are studied. Results show that the total dry weight of the sludges increases with the use of alum, ferric chloride or lime as precipitants or coagulants. In the case of a lime sludge, there is no change of volume after addition of the coagulant or precipitant. The inorganic contents of these sludges are higher and the composition is fairly predictable from a knowledge of the reactions involved and the amounts of particulates and phosphates removed. Anaerobic digestion may be adversely affected but there are other treatment and disposal methods available so that this is not a significant disadvantage. Lime sludges and alum sludges can be reprocessed to recover the precipitants. Alkaline regeneration results in a low quality coagulant.

*Sludge, *Waste water treatment, Sludge treatment, Lime, Salts, Iron, Aluminum, Coagulation, Phosphates, Sludge digestion, Anaerobic digestion, Inorganic compounds, Alkalinity, Chemical precipitation

Ferric chloride, Alum, Phosphate removal, Sludge handling, Particulate matter

D547
NITRATE REDUCTION IN PEAT,

Jaouich, B. A.

Dissertation Abstracts International B, Vol. 36, No. 6, p 2692, December, 1975.

The reduction and removal of nitrogen compounds by biological denitrification in peat using three types of peat, Fibric, Hemic, and Sapric, were studied. Waste water from a local treatment plant was added to 60 cm deep columns of peat at different rates of application. Solutions of nitrate nitrogen from 10 mg/liter to 1000 mg/liter were added to the waste water to test the capacity and duration of the peat renovation system. With residence times between 1.75 and 7 days, Fibric peat was the most promising material for nitrogen removal, followed by Sapric and Hemic. The evolution of nitrous oxide and carbon dioxide was used as an index of biological denitrification. The concentrations of these gases increased as the amounts of nitrate nitrogen added increased. At the end of the experiment, the concentrations of total nitrogen had decreased in the upper layers of Fibric and Sapric, but were generally higher in Hemic. The concentrations of total carbon had decreased most in Hemic followed by Sapric and Fibric. Representative strains of denitrifying Pseudomonas spp., isolated from the peats, were most abundant in Fibric followed by Hemic and Sapric. It was shown that the isolated Pseudomondaceae reduced the added nitrates to elemental nitrogen. The peat waste water renovation system is an effective and inexpensive method for solving waste water problems where suitable land is available. Performance is excellent and operation is relatively simple.

*Waste water treatment, *Peat, Nitrogen compounds, Denitrification, Biological treatment, Microorganisms, Nitrates, Pseudomonas

D548
ION EXCHANGE REMOVAL OF INORGANIC AND ORGANIC WASTEWATER CONSTITUENTS,

Panswad, T.

Dissertation Abstracts International B, Vol. 36, No. 5, p 2431, November, 1975.

A study was conducted jointly by the Denver Water Board and the University of Colorado on the use of ion exchange for demineralizing the Denver Metro waste water. Two anionic resins, Duolite S-37 and A-30B, were studied for their structure and capabilities in simultaneous removal of organic and inorganic materials. The resins were tested in conjunction with a weak acid-strong acid cationic exchanger couple. Using weak base resins prior to and after the cationic couple achieved about a 20% removal of COD. The system consisting of a cationic couple and a degasifier followed by an anionic resin bed was optimized. This system was capable of removing all sulfate ions, about 83% of the chloride ions, and 95% of the orthophosphate over a 200 bed volume throughput. When the system employed S-37 resin, average COD removal was 64.6%. COD removal averaged 50.1% when A-30B resin was used. Treatment costs were 29.4 and 27.2¢/1000 gallons of water treated with S-37 and A-30B, respectively. The addition of activated carbon columns to the end of systems increased the overall average COD removal to 82.6 and 79.2% from the systems containing the S-37 and A-30B resins. The increase in treatment cost was 7.1 and 8.4¢/1000 gallons, respectively.

*Waste water treatment, *Ion exchange, *Municipal wastes, *Water reuse, Activated carbon, Chemical oxygen demand, Resins, Anions, Operating costs, Organic compounds, Inorganic compounds

D549
THERMOPHILIC AEROBIC MICROBIOLOGICAL TREATMENT OF HIGH STRENGTH WASTEWATERS AND RECOVERY OF PROTEIN,

Sueruecue, C. A.

Dissertation Abstracts International B, Vol. 36, No. 5, p 2385, November, 1975.

The thermophilic aerobic treatment of high strength waste waters was studied in both batch and continuous flow systems. The growth requirement of thermophilic organisms in mixed culture, the kinetic behavior of the culture, the effects of solids retention time on the system, and the protein content of the harvested biomass were considered. The rate of growth was highest at 58 C. The minimal nutritional requirements for the organisms included methionine, magnesium, calcium, and iron as well as carbon, nitrogen, and phosphorus. The maximum removal of soluble organic matter was obtained when the system was operated with a solids retention time (SRT) of 5 days or more. A one day SRT achieved 85% COD removal, a 2 day SRT achieved 90% removal, and after 5 days the COD removal was 95%. The specific oxygen utilization rate depended upon the solid concentration and the specific substrate utilization rate which were themselves dependent upon the SRT. No nitrification occurred in any of the SRT systems studied. The thermophilic process is capable of treating high strength waste water more effectively and rapidly and of producing less sludge than a mesophilic system. The biomass produced contained about 45% protein.

*Waste water treatment, *Microorganisms, Bacteria, Chemical oxygen demand, Nutrient requirements, Thermophilic bacteria

Mesophilic bacteria, Solids retention time

D550
WASTEWATER RECLAMATION AND RE-USE: THE RESPONSIBILITIES OF THE CONSULTING ENGINEER,

Tate, C. H.

Dissertation Abstracts International B, Vol. 36, No. 6, p 2695, December, 1975.

The consulting engineer must provide sound input to all phases of waste water reclamation and reuse systems including initial planning, selection of a reclamation process and design of a reuse system. Prior to starting a waste water reclamation and reuse project, careful consideration should be given to preliminary factors including public health implications of reuse, applicable regulatory agency policies, and costs. The responsibilities of the consulting engineer in the various stages of waste water reclamation and reuse are illustrated by case studies. The planning process is described using the Comprehensive Water Quality Control Plan for the San Diego Basin. Testing, evaluation and selection of a recommended reclamation process are discussed with respect to the Prototype Plant Study for the Chino Basin Municipal Water District. The Expansion of the Wastewater Treatment Plant at Walt Disney World, Florida, is discussed as an example of reuse systems.

*Waste water treatment, *Planning, *Design, Water reuse, Sanitary engineering, Public health

D551
INTERMITTENT SAND FILTRATION TO UPGRADE LAGOON EFFLUENTS--
PRELIMINARY REPORT,

Reynolds, J. H., Harris, S. E., Hill, D., Filip, D. S., and
Middlebrooks, E. J.

In: Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards, August 21-23, 1974, Logan, Utah, Utah State University, p 71-88. 15 fig, 6 tab, 9 ref.

Intermittent sand filtration can be used in communities surrounded by large areas of open land. The performance of the filters in full-scale tests were evaluated and compared to results obtained using laboratory and pilot scale field intermittent sand filters. The ultimate objective was to develop design criteria that will consistently produce an effluent that would meet stringent water quality standards. Sand with an effective size of 0.17 mm was tested in six filters. Hydraulic loading rates of 0.2, 0.4, 0.6, 0.8, 1.0, and 1.2 mgad were used. Samples were collected and analyzed for suspended solids, biochemical oxygen demand, chemical oxygen demand, total phosphorus, orthophosphorus ammonia, nitrite, pH, temperature and dissolved oxygen. Different types of algae were used in this experiment from laboratory and pilot scale tests, but this had little effect on the filter performance. Results show that the length of the filter runs depended on the algal concentration and the hydraulic loading rates. The filter run was shorter in this test than in the laboratory and pilot scale tests. It varied from 14 days with a hydraulic loading rate of 1.2 mgad to 42 days with a hydraulic loading rate of 0.4 mgad. Twice as much of the total suspended solid matter was removed by filters with a hydraulic loading rate of 0.6 mgad than with a loading rate of 1.2 mgad. Suspended solids were reduced to less than 7.2 mg/liter from an average of 26.1 mg/liter and volatile suspended solids were reduced to less than 1.5 mg/liter from an average of 16.9 mg/liter for all filters. These full scale tests essentially confirmed the previous laboratory and pilot scale studies.

*Sand, *Filtration, *Lagoon, *Effluent, *Filters, *Algae, Waste water treatment, Design criteria, Water quality standards, Standards, Chemical analysis, Suspended solids, Biochemical oxygen demand, Chemical oxygen demand, Nitrites

*Intermittent sand filters, Hydraulic loading rates

D552
PERFORMANCE OF RAW WASTE STABILIZATION LAGOONS IN MICHIGAN
WITH LONG PERIOD STORAGE BEFORE DISCHARGE,

Pierce, D. M.

In: Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards, August 21-23, 1974, Logan, Utah, Utah State University, p 89-135. 4 fig, 15 tab.

Conditions under which secondary treatment requirements could be met by raw waste stabilization lagoons are determined. Forty nine municipal lagoon systems typifying features of construction, loadings and maintenance and operational practices which readily accomodate a common mode involving long period storage followed by control short period discharge were chosen in Michigan. Records from the forty nine plants were reviewed and recorded for analyses of BOD and suspended solids. These data were analyzed statistically in terms of probability of occurrence. In-depth studies were made of fecal coliform data to determine seasonal trends in their levels. No relationship was found between fecal coliform levels and BOD and suspended solids levels. Results showed that the lagoons studied can consistently produce effluents meeting EPA requirements for BOD and fecal coliforms and can generally meet standards for suspended solids. Supplementary studies were undertaken: to evaluate performance of raw waste stabilization lagoons in other northern states when managed in similar ways; to examine the methods in use and results of chlorination for coliform bacteria destruction both at lagoons so managed and those with continuous discharge; and to collect available data on nitrification phenomena. Other raw waste stabilization lagoons with long period storage and intermittent discharge were studied in Minnesota; North Dakota; Upper Peninsular, Michigan; and Belding, Michigan. Chlorination at continuous discharge stabilization lagoons was studied in Chesterfield Township, Michigan, and Illinois. Chlorination of lagoon contents, lagoons following secondary treatment and aerated lagoons were also studied.

*Stabilization, *Lagoons, *Storage, *Waste storage, Municipal wastes, Waste water treatment, Illinois, Michigan, North Dakota, Minnesota, Coliforms, Bacteria, Suspended solids, Treatment, Discharge (water), Chlorination, Aerated lagoons, Water quality standards

D553
UPGRADING LAGOON TREATMENT WITH LAND APPLICATION,

Thomas, R. E.

Robert S. Kerr Environmental Laboratory,
Environmental Protection Agency,
Ada, Oklahoma, Water Quality Control Branch.

In: Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards, August 21-23, 1974, Logan, Utah, Utah State University, p 183-186. 9 refs.

Land application to upgrade lagoon treatment of waste waters is a promising approach. Some techniques that are not in common use at the present time include: crop irrigation; infiltration-percolation; and overland flow. The uses of these techniques are described with relation to developing technology and approaches that have been used for many decades. Crop irrigation is an alternative which has been used for many decades with a high degree of success under a variety of climatic conditions. Existing systems can provide much information on design and operating experiences which have led to problems as well as successes. Infiltration-percolation is another alternative which has limited but widespread use for advanced waste treatment of secondary effluent. This process usually follows activated sludge or trickling filters as the secondary treatment process. The information on design and operating experience following lagoon treatment is not extensive. Information on infiltration-percolation following other conventional processes for achieving secondary treatment can be used by those contemplating infiltration-percolation for upgrading lagoon treatment. Overland flow is being evaluated for upgrading secondary effluents and for complete replacement of conventional secondary treatment processes.

*Lagoon, *Treatment, Waste water treatment, Overland flow, Infiltration, Crops, Percolation, Irrigation, Design, Effluens

Secondary treatment, Secondary effluent, Land application

D554
WASTEWATER REUSE BY CONTINUOUS ION EXCHANGE,

Gold, H., and Todisco, A.

In: Complete WateReuse: Industry's Opportunity, April 23-27, 1973, American Institute of Chemical Engineers and Environmental Protection Agency--Technology Transfer, p 96-103. 3 fig, 1 tab, 13 ref.

Ion exchange has been used in industry for many years in the recovery of valuable substances from industrial liquids and the purification of these liquids for their reuse. It is the treatment of water with solid adsorbants. The economic limitation on this process comes from the expensive regenerant that must be used in order to obtain the original ion exchange resin again. Difficulties arise because in many cases, substances that are to be removed are in low concentrations. Most of the ion exchange units presently in use are of the conventional downflow fixed bed, batch operated type. The Avco continuous moving bed process is described. This design consists of a moving bed in which the resin is kept continually moving through the column. The ion exchange, regeneration and wash operations occur simultaneously in the same column. Some operating problems resulting in higher maintenance costs have been experienced in continuous bed systems, but these must be weighed against the cost advantages resulting from higher regeneration efficiencies and lower waste stream volume. Principles of operation of this system are illustrated for water softening. Tests were carried out to evaluate the performance of this system. The most critical problem was the propulsion of the resin bed in a steady plug flow against the effects of bridging and pulsing. Hydraulic and mechanical properties of the moving packed bed system and the effects of compaction on permeability of the resin bed were investigated.

*Waste water treatment, *Water reuse, *Ion exchange, *Water treatment, Economics, Resins, Cost comparisons

Avco, Continuous moving bed, Regeneration, Continuous ion exchange

D555
THE MEANING OF ULTIMATE DISPOSAL,

Dean, R. B.

National Environmental Research Center,
Cincinatti, Ohio,
Advanced Waste Treatment Research Laboratory.

In: Complete WateReuse: Industry's Opportunity, April 23-27, 1973, American Institute of Chemical Engineers and Environmental Protection Agency--Technology Transfer, p 135-139.

The reuse and ultimate disposal of industrial waste waters are discussed. Industrial waste waters can be discharged after suitable purification; they can be evaporated; or they can be purified and reused. Reuse means eventually all dissolved or suspended materials must be accounted for. Those that can not be thrown away, given away, or sold must be stored somewhere. Careful housekeeping can eliminate some and reduce many other wastes. Wastes that are necessary by-products will accumulate in quantities that cannot be further reduced by any waste control program. Removing water minimizes the volume of the waste to be stored, but the cost of drying must be balanced against the reduced cost of storage. Wastes can be converted to useful products only if the cost of conversion can be justified by the market value of the products. Careful segregation of waste streams can reduce the cost of treatment and disposal substantially, and may permit profitable recovery of some of the toxic wastes.

*Ultimate disposal, *Water reuse, *Water utilization, Waste water disposal, Waste disposal, Industrial wastes, Waste storage, Storage, Disposal, Costs

Volume reduction

D556
SLUDGE REMOVAL FROM DRYING BEDS,

Public Works, Vol. 106, No. 11, p 64, November, 1975.

Sludge drying beds at a municipal waste water treatment plant in Hartford, Wisconsin, have been cleaned by a small track-type loader. Each bed has a 70,000 gallon capacity and is constructed with a 17-inch deep bed of graduated sand and gravel over a grid of 8-inch tile pipe. Dried sludge must be removed monthly. A heavy machine would break the tile drains; manual cleaning proved to be slow and costly. A one cubic yard, 65 hp track-type loader was found to be powerful enough to clean the beds efficiently but had a tolerable pressure on the tile of about 10.1 psi. The loader's bucket teeth were removed and the bucket edge was set so as to skim off the sludge. Dried sludge will be hauled to a pickup point where it may be distributed to local citizens for fertilizer. The loader then smooths out the sand surface to prepare the drying beds for the next sludge application. The entire operation for each 45 x 165 ft bed takes about four hours.

*Sludge disposal, *Waste water treatment, *Municipal wastes, *Construction, *Equipment, Sludge treatment, Cleaning, Recycling

Track-type loader, Sludge removal, Drying beds

D557
STATE OF THE ART OF LAGOON WASTEWATER TREATMENT,

McKinney, R. E.

Kansas University,
Lawrence,
Department of Civil Engineering.

In: Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards, August 21-23, 1974, Logan, Utah, Utah State University, p 150-20.

Current knowledge on the advantages and disadvantages of oxidation ponds is discussed. Used extensively in small communities and isolated industries in the United States, oxidation ponds have the advantage of simplicity of construction, design and operation, along with the product of a highly stabilized effluent. It was found that oxidation ponds worked differently in different parts of the country. Little operational data had been gathered. There existed the need to know exactly how oxidation ponds worked and to examine the alternatives if it were found necessary to replace them. Studies showed that the size of oxidation ponds depends on the size of the population being served, the rate of rainfall compared to the rate of evaporation, and the length of the winters. Research performed on the biological reactions showed them to be much more complex than those that were previously thought to control the process. An understanding of the microbiology was not considered essential when designing oxidation ponds, but it could help. Temperature and temperature changes were found to be important in effecting metabolism rates. After a total evaluation of all the factors involved, it appears that oxidation ponds have their place in waste water treatment. With proper design using multiple ponds and adequate holding time and properly designed transfer and effluent pipe structure, oxidation ponds can produce a satisfactory effluent when considerations are made for evaporation.

*Oxidation lagoons, *Lagoons, *Waste water treatment, *Reviews, Microbiology, Biological treatment, Effluents, Rainfall, Evaporation, Design criteria, Design, Temperature, Ponds

Oxidation ponds, Multiple ponds

D558
REVIEW OF EPA RESEARCH AND DEVELOPMENT LAGOON UPGRADING PROGRAM FOR FISCAL YEARS 1973, 1974, and 1975,

Lewis, R. F.

National Environmental Research Center, Cincinnati, Ohio,
Advanced Waste Treatment Research Laboratory,
Office of Research and Development.

In: Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards, August 21-23, 1974, Logan, Utah, Utah State University, p 3-14. 14 fig, 5 tab, 7 ref.

The Environmental Protection Agency Research and Development Program for upgrading the performance of lagoon waste water treatment systems is reviewed. Approximately 90% of all of the waste water lagoons in the United States are located in communities of 10,000 people or less. Therefore, very little monitoring or analysis of influents or effluents takes place. A comprehensive survey taken of lagoons all across the country evaluated biochemical oxygen demand and suspended solids for facultative lagoons, aerated lagoons, oxidation ditches, and tertiary lagoons. The EPA and its predecessor organizations have sponsored several meetings and research projects on the general topic of waste water lagoons and in a few cases on means of upgrading lagoons. A vigorous lagoon upgrading program has been spurred by the passage of new standards for effluent BOD and suspended solids. Research needs for lagoon upgrading, which have been identified by a variety of state, academic and private groups, are presented. Projects for fiscal year 1973 included the removal of algae from lagoon effluents and a revision of the manual on algae and water pollution. Projects for 1974 were on the performance of evaluating existing facultative lagoons and the Lagoon Workshop Symposium. Projects that were planned for fiscal year 1975 include a chlorine disinfection study, the nitrification of lagoon effluent with a rotating biological contactor, and combined nitrogen and phosphorus control in a lagoon. A summary of funding for lagoon upgrading projects is given. It is hoped that funds will soon be available to study well-designed aerated lagoons and aerated/facultative lagoon combinations.

*Lagoons, *Aerated lagoons, *Oxidation lagoons, *Waste water treatment, *Reviews

D559
NEW SEWAGE PLAN STUDIED ON WEST COAST,

Compost Science, Vol. 16, No. 5, p 9, Autumn, 1975.

A new sewage treatment system is being developed in which a pyrolysis furnace burns or bakes material without the oxygen necessary in conventional combustion, at temperatures of up to 1500 F, thus reducing the fuel to elemental carbon. This furnace may be used to process sewage sludge. Solids are extracted from the sewage and burned to produce the activated carbon which is then used to filter the remaining sewage effluents. The resulting effluent is of a quality at least as clean as the product of conventional two-stage sewage treatment. The only residue of this system is a small amount of inert ash, and no sludge is produced. The process was developed by space-flight engineers at the Jet Propulsion Laboratory in Pasadena, California. A two-million dollar pilot plant will be constructed south of Los Angeles with a capacity of one mgd. The plant will be financed by the EPA and by state and municipal funds. Capital costs should be about 25% below that of a conventional secondary treatment facility.

*Sewage treatment, *Treatment facilities, *Burning, Pilot plants, Capital costs, Waste water treatment, Equipment, Recycling

Pyrolysis, Secondary treatment

D560
POLISHING LAGOON EFFLUENTS WITH SUBMERGED ROCK FILTERS,

O'Brien, W. J.

Kansas University, Lawrence,
Department of Civil Engineering.

In: Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards, August 21-23, 1974, Logan, Utah, Utah State University, p 31-46. 6 fig, 12 tab, 21 ref.

Lagoons have been widely used in small communities and isolated industrial plants in the United States for many years. Removal of algae from the final effluent can be costly if done by standard techniques. Submerged rock filters, which have the potential for avoiding this cost, have been tested in laboratory scale and pilot scale units. Field scale trials are reported in this paper. Two filters were tested: large rock and small rock. Samples were obtained from the lagoon effluent, the influent to the experimental lagoon and the effluent leaving the large rock and small rock filters, and were analyzed for total solids, volatile suspended solids, chemical oxygen demand, biochemical oxygen demand, ammonia, nitrogen, phosphorus, chlorophyll and pH. In the first six months of operation, the field scale installation responded the same way as the pilot scale had, as the biological slime layer was becoming established on the rock surfaces. Once this was established, the capture of suspended solids increased. Aeration facilities must be provided for the effluent part of the year. If the total alkalinity is greater than 260 mg/liter of calcium carbonate, there will be no odor problem. Effective filter life should be greater than 29 to 30 years. Rock sizes between 2.54 cm and 12.70 cm will make satisfactory filters. Most rocks in a filter should be within a range of 5 cm. More investigation is needed to investigate the relationship between rock size and hydraulic loading. Tentative guidelines can be designed for submerged rock filters.

*Lagoon, *Effluents, *Rocks, *Filters, Algae, Chemical analysis, Alkalinity, Chemical oxygen demand, Biochemical oxygen demand, Suspended solids, Nitrogen, Phosphorus, Ammonia, Slime, Chlorophyll, Aeration, Waste water treatment

D561
POST-TENSIONING SYSTEM REPAIRS OLD DIGESTERS,

Beyaz, Z.

Brown and Caldwell,
Consulting Engineers,
Walnut Creek, California.

Public Works, Vol. 106, No. 11, p 70-71, November, 1975.

A new tensioning technique has been employed to rehabilitate a Stockton, California, treatment facility for about one third the cost of building a new facility. Three primary sludge digester tanks of an old design have been modified. All existing rods and defective gunite to two feet below ground level were stripped and the walls were sandblasted. Then one to 1 1/4 inches of gunite was applied as a leveling coat to permit continuous contact of the new tensioning rods. The rods were than paced and stressed. The new stressing method uses 160,000 psi alloy steel bands which are assembled on the ground and pulled up as hoops or placed on hanger bars. Once in place, the ends of the bars are pulled together with a hydraulic scissors-jack. After the exact load is achieved, the bar ends are fastened with couplers and tension is checked. The method works well around pipes connected to the tank or through the tank wall. Labor costs are about 30% of the total tensioning costs.

*Construction, *Sludge treatment, *Waste water treatment, Treatment facilities, Repairing, Equipment, Costs, Concrete

Tensioning, Digesters

D562
STABILIZATION POND UPGRADING WITH INTERMITTENT SAND FILTERS,

Middlebrooks, E. J., and Marshall, G. R.

Utah State University, Logan,
College of Engineering.

In: Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards, August 21-23, 1974, Logan, Utah, Utah State University, p 47-69. 8 fig, 19 tab, 13 ref.

Intermittent sand filtration can be used in communities surrounded by large areas of open land. The performance of the filters on a laboratory and pilot field scale was evaluated. Nine laboratory scale filters and nine field filters were evaluated. Sands used had effective sizes of 0.17, 0.35, and 0.72 mm. Hydraulic loading rates of 100,000 gpad, 200,000 gpad, and 300,000 gpad were used. Suspended solids, pH, and temperature were measured once every day, and samples were analyzed once a week for biochemical oxygen demand, ammonia, nitrate, nitrite, orthophosphate, phosphorus, suspended solids and pH. Hydraulic loading rate had little to do with any of the parameters in the laboratory tests, but in the field tests increased hydraulic loading caused a decrease in the suspended solids removal. Smaller size sands oxidized nitrogen compounds better. In the laboratory, hydraulic loading rates had little effect on the ability of sand to oxidize nitrogen. Ammonia primarily provided the nitrogen which was oxidized. After equilibrium was established, the intermittent sand filters did not remove a significant quantity of dissolved phosphorus compounds. BOD removal increased as the effective sand size decreased, as did algal and suspended and volatile solids removals. Some algae cells passed through the entire sand column without being removed. All waste water treatment plants can be upgraded by intermittent sand filtration to meet Class 'C' standards in the state of Utah. The process can be constructed and operated at a cost ranging between 15 and 47 dollars per million gallons of filtrate.

*Oxidation lagoons, *Stabilization, *Ponds, *Lagoons, *Sands, *Filters, Chemical analysis, Biochemical oxygen demand, Ammonia, Nitrates, Nitrites, Suspended solids, Oxidation, Algae, Utah, Standards, Waste water treatment, Water quality standards

D563
UNDERWATER SEDIMENT REMOVED WITH MINIMUM TURBIDITY,

Water and Pollution Control, Vol. 113, No. 11, p 9, November, 1975.

A machine has been developed to clean sediment from the bottoms of municipal reservoirs and industrial settling ponds. The Mud-Cat, operated by Boice Construction of Edmonton, Canada, is a self-propelled barge fitted with an eight-foot wide horizontal auger mounted on a hydraulically operated boom. The Mud-Cat pulls itself forward along a guide cable along the water and scoops up weeds, mud, silt, sand, sludge, and industrial wastes. Turbidity is eliminated by a special mud shield located above the auger. The machine can remove from 50 to 120 cu yd of material per hour. The auger and cutter are hydraulically raised and lowered, enabling the machine to follow the natural contours of a pond bottom without damaging a natural or artificial seal. The Mud-Cat has been used by the oil industry, for an irrigation reservoir, for removing paper fiber wastes, and for cleaning flood silt, sludge, and coal slurries in the United States and Canada.

*Turbidity, *Waste treatment, *Oil wastes, *Sediments, Cleaning, Reservoirs, Settling basins, Sludge disposal, Industrial wastes, Mud, Equipment

Mud-Cat

D564
SIMULATION OF LEAD REMOVAL BY CHEMICAL TREATMENT,

Naylor, L. M., and Dague, R. R.

American Water Works Association Journal, Vol. 67, No. 10, p 560-565, October, 1975. 8 fig, 18 ref.

Lead enters surface waters as a result of air scrubbing by rain and snowfall, from urban land runoff, from the exhaust of power boats, and from waste water effluents. In this study, the fate of lead in surface waters and the effectiveness of three water treatment processes in lead removal were considered. On a laboratory scale, alum coagulation, lime, and lime-soda ash softening were evaluated. The chemical softening process was evaluated with both conventional and solids-contact modes of operation. Results of the laboratory tests showed that the solids-contact method removed nearly all the lead over a wide range of contact solids concentrations. The conventional chemical softening is effective for lead removal in a pH range of 9.2 to 10.4. Coagulation and flocculation with alum resulted in lead removal at pH levels of 8 to 9 but not near neutral values. The solubility of lead in surface waters is limited primarily by alkalinity and pH.

*Lead, *Model studies, *Lime, *Coagulation, Water treatment, Surface waters, Analytical techniques, Alkalinity, Hydrogen ion concentration, Laboratory tests, Storm runoff

D565
AWT PLANT CUTS NUTRIENTS ECONOMICALLY,

Singhal, A. K.

Ayres, Lewis, Norris, and May, Incorporated,
Ann Arbor, Michigan,
Systems and Studies Department.

Water and Wastes Engineering, Vol. 12, No. 11, p 89-92, November, 1975. 2 fig, 4 tab.

Expansion of a Cadillac, Michigan, waste water treatment plant to include tertiary treatment facilities has been accomplished without disturbing the operation of the existing plant. The new advanced waste water treatment plant consists of a biological system attached to rotating discs, combined with shallow bed rapid sand filters. This achieves a very high quality of effluent, particularly in terms of phosphorus removal and nitrification. The use of rotating discs for ammonia nitrogen removal was compared with extended aeration; the rotating disc system was both cost effective and easier to operate and maintain. Tests have been conducted on process requirements. A full scale plant study using ferric chloride and polymer was also conducted. By moving the point of addition of ferric chloride towards the tail end of the aeration tanks and by attaining optimum shear velocity by adjusting the quantity of air, phosphorus removal efficiency has been improved from 60% to 85%. A rational approach for the design of a flocculation system for phosphorus removal in an aeration system was also detailed.

*Waste water treatment, *Treatment facilities, *Tertiary treatment, *Biological treatment, *Aeration, *Polymers, Flocculation, Costs, Filters, Nutrient removal, Michigan, Nitrification

Rotating biological discs, Sand filters, Ammonia nitrogen removal, Phosphorus removal

D566
THE PHYSICAL METHOD OF WATER STERILIZATION,

Summer, W.

Process Biochemistry, Vol. 10, No. 9, p 43-46, November, 1975. 3 fig, 6 tab.

Physical methods of water sterilization have been proposed to produce potable water supplies from heavily contaminated water, particularly in emergency situations. Two methods described were ultra-violet irradiation and ozonation. The design of ultra-violet water treatment equipment was detailed. Ultra-violet energy at bactericidal wavelengths cannot achieve direct oxidation of organic contaminants suspended in a liquid. For this purpose, ozone is used effectively, rather than a chemical oxidant such as chlorine. If ozone is used as the oxidant in addition to uv sterilization, only small ozone quantities are required. The kinetics of ozone production for this purpose were outlined. The absorption of ozone in water as related to temperature and the usage of ozone as a bactericide in industrial water treatment were also discussed.

*Water treatment, *Ozone, *Ultraviolet irradiation, Design criteria, Equipment, Waste water treatment, Water supply, Kinetics, Potable water

Emergency water supplies

D567
BROOKHAVEN'S TWO SEWAGE TREATMENT PLANTS,

Small, M. M.

Brookhaven National Laboratory,
Upton, Long Island, New York,
Applied Science Department.

Compost Science, Vol. 16, No. 5, p 7-9, August, 1975. 1 fig.

Two schemes are being operated which treat 10,000 gpd sewage water on Long Island and return potable water to the groundwater supply system. A land intensive system, the Meadow/Marsh/Pond (M/M/P) scheme offers crops for harvest and sale. The second scheme, the Marsh/Pond system, requires less land. The M/M/P system consists of the dumping of raw sewage and septic tank sludges into a box where they are screened to remove bulky objects, passing these through a degritter to remove sand and other nondegradable material, and communition to reduce degradables to fines. The mixture is then passed into aeration ponds, treated by aeration, and pumped to a distribution header feeding overflow boxes at the heads of two sloped meadows. One meadow is used at a time; the other is dried for harvesting. By gravity flow through the sloped meadow, the influents are passed to a marsh, then to a stabilization pond stocked with aquatic species. With normal domestic sewage and sludges, pond effluent will be of potable water quality. An average of 50% of the treated influents are reused. The entire process takes place on an underlying impervious membrane so that no contaminants may be lost to the ground. Effluents are monitored prior to discharge. The Marsh/Pond concept is similar, but has no cash crop for nutrient removal and operates continuously, thus eliminating the margin for drying out, dry harvest, or operational corrections. The M/M/P system is a combination sewage treatment plant, aquaculture site, and farm. Cost analyses have not yet been performed.

*Sewage treatment, *Water quality control, *Aeration, *Recycling, *Water reuse, Potable water, Aquaculture, Waste water treatment

Meadow/Marsh/Pond system, Marsh/Pond system, Land disposal

D568
PILOT-SCALE WASTEWATER TREATMENT STUDIES,

Tebbutt, T. H. Y.

The Public Health Engineer, Vol. 17, p 129-135, September, 1975. 10 fig, 7 tab, 15 ref.

A pilot scale sewage treatment plant was constructed at Birmingham University, Great Britain, in order to investigate the performance relationships for several unit processes in sewage treatment. Data on plant loading conditions, settling efficiency, performance of individual runs, and on the sludge characteristics were compiled and analysed. Results indicated that: the performance of a primary sedimentation tank is influenced by the hydraulic loading and also by the initial concentration of suspended solids. A modification of Fair's retarded biological oxidation formula, which involves expressing the degree of treatment as the product of mixed liquor volatile suspended solids and aeration time, provides an acceptable fit to semi-batch activated sludge data. It was also demonstrated that increased primary tank loading produces a decrease in the treatability of settled sewage with respect to biological oxidation. Additionally, the nature of the sludge produced from primary and secondary treatment will not be much affected by variations in the primary tank hydraulic loading.

*Pilot plants, *Sewage treatment, *Performance, *Sedimentation, *Biological treatment, Sludge, Waste water treatment, Treatment facilities

Hydraulic loading

D569
MODIFICATIONS IMPROVE CHLORINE CONTACT CHAMBER PERFORMANCE,

Hart, F. L., Allen, R., DiAlesio, J., and Dzialo, J.

Worcester Polytechnic Institute, Massachusetts,
Civil Engineering Department.

Water and Sewage Works, Vol. 122, No. 10, p 88-90, October, 1975. 6 fig, 3 tab, 15 ref.

Part two of a study on modifications to improve chlorine contact chamber performance, presenting the second and third stages, is discussed. After establishing a hydraulic similarity between the field tank and the laboratory scale model tank in the first stage, a detailed study of the model tank flow patterns is conducted in stage two to provide data that will lead to model tank modifications. Results at three water levels are graphically presented. Undesirable hydraulic patterns were experienced and corrective measures were taken. Results for this modified chamber were also illustrated. In stage three, rhodomine WT dye tracer evaluations were conducted to determine the degree of hydraulic improvement to the chlorine contact system. Output response function values for the modified model chamber and a percent difference comparison with the unmodified model chamber were tabulated. The three sampling points are uniform for the modified chamber as compared to the unmodified chamber. The hydraulic pattern was shown to generally improve. A reduction of mixing patterns was indicated. Output response function data were graphically illustrated. The modified chamber approximates the ideal plug flow system closer than the unmodified chamber.

*Chlorine, *Hydraulics, Waste treatment, Waste water treatment, Graphical analysis, Flow, Flow characteristics, Model studies, Tracers

*Chlorine contact chamber, Plug flow system

D570
SEWERAGE AND SEWAGE DISPOSAL,

Kirkaldy, I. D.

Chartered Municipal Engineer, Vol. 102, No. 11, p 219-221, November, 1975.

A historical review of sewerage and sewage disposal is presented. Legislation governing the disposal of wastes to rivers near cities has been passed since the fourteenth century in Britain. Commissions appointed in the last century to study river pollution came out in favor of land disposal or irrigation as a possible use of wastes. Prior to the recent reorganization, sewerage and sewage disposal was administered by almost 1400 authorities. Even after reorganization, a split existed between sewerage and sewage disposal. Confusion has been caused by the difference in the methods of finance brought about by reorganization. Water authorities are also experiencing difficulties in obtaining realistic figures from local authorities on current schemes. There is much speculation on the continuing role of district councils as agents for the water authority in sewerage matters. Advantages of the reorganization can not be determined in the short term. Time and effort is involved but eventually a more rational system will evolve. The aim should be the consideration of regionalization of treatment facilities where possible. Proposals for the South Hampshire main drainage project are considered in this light. The final scheme was adopted after much investigation and deliberation. For new disposal works, the cost of automation should be weighed against the rise in labor costs. Precise knowledge of all of the interrelations of parameters in sewage treatment processes is lacking, and complete automation should be avoided. Sludge incineration and dewatering systems on the continent should be investigated.

*Sewerage, *Sewage disposal, *Sewage, *Disposal, Waste water disposal, History, Treatment facilities, Financing, Automation

Water Authorities, Great Britain, South Hampshire (Great Britain)

D571
THE USE OF ADENOSINE TRIPHOSPHATE MEASUREMENTS IN THE CONTROL OF THE ACTIVATED SLUDGE PROCESS BY THE SOLIDS RETENTION TIME METHOD,

Statham, M. and Laugton, D.

University College, Cardiff, Great Britain, Department of Microbiology.

Process Biochemistry, Vol. 10, No. 8, p 25-28, October, 1975. 6 fig, 4 tab, 12 ref.

Successful operation of the activated sludge process requires that the sludge settle quickly or the quality of the final effluent will be severely reduced. Experiences in the control of an activated sludge plant are described. Some problems that have arisen in the control of the plant being studied are: it must be run as two lanes of four aeration pockets; it is impossible to operate at a recycle ratio of less than 0.5; and surface water infiltrates into the sewerage system. In an attempt to control the plant, observations were made of biochemical oxygen demand (BOD), flow rate, recycle rate, wastage rate, mixed liquor suspended solids (MLSS), sludge volume index (SVI), and a relatively novel parameter, the adenosine triphosphate concentration (ATP). The theory of solids retention time (SRT) is discussed. For the sludge to have good settling characteristics, the food to microorganism ratio must be kept within certain limits. A model is described that relates microorganism growth to this ratio or loading factor to calculate the sludge wastage rate. The method developed of SRT control requires only flow data and no laboratory work. ATP extraction procedures and measurement techniques are described. Standard techniques were used to measure MLSS, BOD, and SVI. Results show that for SVI values lower than 250, ATP concentration is related to SVI. SRT's of six to nine days should be avoided in the plant studied. For the best BOD removal efficiencies, higher SRT's are required. The SRT method of control is strongly recommended.

*Activated sludge, *Sludge treatment, Waste water treatment, Biochemical oxygen demand, Treatment facilities, Flow rates, Suspended solids, Microorganisms

*Adenosine triphosphate, *Solids retention time, Mixed liquor suspended solids, Sludge volume index

D572
SEWAGE AS A RESOURCE,

Coldrick, J.

Wessex Water Authority, Bristol, England, Operations Directorate.

New Scientist, Vol. 68, No. 973, p 276-278, October 30, 1975.

A large portion of the capital expenditure of Britain's Regional Water Authorities will be spent on new sewerage schemes or new sewer treatment facilities. The work of the Wessex Water Authority, which uses sewage as a resource, is discussed. Though there may be no universally applicable sewage treatment process, certain principles always apply. Sludges produced from primary treatment differ from sludges produced from secondary treatment. The sludge can be treated by anaerobic or aerobic digestion, heat treatment, air drying, or mechanical dewatering. The aim is to produce as cheaply as possible a residue that is non-toxic, non-polluting and inoffensive. Sea disposal is economic and can be of benefit to marine life. Application to agricultural land is particularly valuable. A small proportion of air dried sludge is sold as fertilizer and soil conditioner. In most cases, this sludge is given away to farmers. The sludge gas produced in the digestion process can be used as a source of energy. The possibility of using sludge gas for vehicular propulsion has been considered, but the scrubbing and compression costs make it a less attractive proposition. Sewage effluents can be used in cooling or quenching processes or in cement works where high grade water is not necessary. Sewage has been used in fish production in parts of Europe to good advantage. Another possibility is the growing of algae in sewage to reduce inorganic pollution.

*Sewage, *Sewage treatment, Waste water treatment, Sewage disposal, Waste water disposal, Sludge, Sludge digestion, Treatment, Disposal, Sewage effluents, Resources

*Sewage utilization, *Sludge utilization, Sewage resources, Great Britain

D573
EXPERIMENTAL WORK ON THE SETTLEMENT OF SEWAGE,

Stones, T.

Effluent and Water Treatment Journal, Vol. 15, No. 10, p 529, 531, 533, 535, 537-541, October, 1975. 10 fig, 12 tab, 7 ref.

A review of the experimental work on the settlement of sewage is presented. Despite its chemical complexity, the constituents of sewage can be classified into four groups: large solids which can be removed by screening; coarse suspended solids which can be separated by sedimentation; finely dispersed solids which can be separated only after uniting into larger particles; and soluble solids. Biological sedimentation, pre-aeration, chemical precipitation, and mechanical flocculation are discussed. It has been shown that a greater amount of biological purification occurs during tank treatment than was previously thought. Toxic constituents may interfere with the sedimentation stage. It is concluded that tank treatment provides biological purification, settles the solids, and balances the fluctuations in strength in the incoming sewage. Pre-aeration has no effect on the character of the sewage after settlement and it does not promote the deposition of solids during settlement. It may help maintain aerobic conditions. Small dosages of lime and acid, added for chemical precipitation, may hinder purification because of the suppression of the biological purification that they may cause. Mechanical flocculation promotes good floc formation of coagulated matter, which then settles rapidly. However, it was found to be effective only when used in conjunction with a coagulating agent added for chemical precipitation.

*Sewage, *Sewage treatment, Waste water treatment, Chemical precipitation, Toxicity, Biological treatment, Flocculation, Sedimentation, Aeration, Suspended solids

Mechanical flocculation

D574
CIL TO TEST NEW SEWAGE UNIT,

Canadian Chemical Processing, Vol. 59, No. 10, p 32, 34, October, 1975. 1 fig.

Canadian Industries Limited (CIL) has designed a deep shaft sewage treatment process that will handle biodegradable effluents at a lower energy input than the activated sludge process. The principal is based on a corollary of Henry's Law: the solubility of a gas in a liquid increases under pressure. A deep column allows more air absorption than do surface aerators. The process consists of a shaft a few hundred feet deep partitioned into two vertical sections. Screened, degritted sewage is pumped into the center column and mixes with an air stream and a biological culture. This provides oxygen and assures that the incoming fluid moves downward and the outgoing, aerated liquid moves upward. Estimates show that this system will require about 50 to 70% of the power used in the activated sludge process. Tests have shown that 90% of the oxygen in this process will undergo reaction, whereas in the activated sludge process, only 10% undergoes reaction. This means that less sludge and more carbon dioxide will be produced. The economics of oxygen enrichment do not look promising because of the increased solubility. Cryogenic oxygen was offered at 15 dollars per ton. Atmospheric oxygen could be fed into the system for 6 dollars per ton for small systems and 3 dollars per ton for large systems.

*Sewage treatment, Sewage, Waste water treatment, Effluents, Oxygen

*Deep shaft process, Henry's Law, Canadian Industries Limited

D575
MUNICIPAL WASTEWATER RECLAMATION--AN INDUSTRIAL WATER SUPPLY,

Petrasek, A. C., Esmond, S. E., and Wolf, H. W.

In: Complete WateReuse: Industry's Opportunity, April 23-27, 1973, American Institute of Chemical Engineers and Environmental Protection Agency--Technology Transfer, p 689-703. 2 fig, 12 t..b, 9 ref.

Considerable reuse of municipal waters by industry is practiced at this time. Industrial water supply problems and requirements are reviewed. Water quality depends a great deal on whether it will be used as a coolant or as boiler feed. If used for cooling, the waters must not deposit scale, corrode the systems, encourage the growth of slime, or deteriorate wood. Water used for boiling must be free from silica, aluminum, sodium, and potassium. Specific requirements are presented for the textile, lumber, paper, chemical, petroleum, metals, tanning, cement, and food and soft drink canning industries. Tests were performed at a treatment facility on two different treatment sequences. The biological-physical sequence included the following operations: screening and degritting; primary sedimentation; completely mixed activated sludge; multi-media filtration; and disinfection. The biological-physical-chemical sequence included: screening and degritting; primary sedimentation; completely mixed activated sludge; chemical treatment; multi-media filtration; activated carbon adsorption; and disinfection. Primary effluents, although not of high quality, have certain applications as cooling waters and in the lumber and metals industry. Activated sludge effluent can be used in the lumber, petroleum, metals, cement, and paper industries. When filtered, this water can be used also in the tanning industry. After filtering, this water can be used in finishing and rinsing processes. After activated carbon adsorption, the effluent is considered of excellent quality and the water can be used for all industries except those requiring potable water.

*Municipal wastes, *Industrial water, *Reclaimed water, *Reclamation, *Water reuse, Treatment, Waste water treatment, Treatment facilities, Activated sludge, Activated carbon, Biological treatment, Effluents, Water requirements, Potable water

Chemical treatment, Physical treatment

D576
HANDLING OF SOLIDS AND LIQUID SIDESTREAMS RESULTING FROM WATEREUSE OPERATIONS,

Kalinske, A. A.

In: Complete WateReuse: Industry's Opportunity, April 23-27, 1973, American Institute of Chemical Engineers and Environmental Protection Agency--Technology Transfer, p 140-146. 25 ref.

Waste water treatment processes should be considered as one step of water treatment processes. The eventual disposal of the solid and liquid pollutants and residues that are removed by various treatment processes are discussed. The basic ultimate disposal processes are discussed. Biological treatment by means of the activated sludge process can remove considerable amounts of biodegradable organic matter. The exact amount depends on the food to microorganism ratio and the type of organic matter that is present. Other methods include a rock trickling filter, rotating disc contactor and an aerated packer tower. Another process that reduces organic matter is adsorption onto activated carbon. The rapid sand filter has been used by municipal water treatment plants for almost seventy five years, and the basic design has remained unchanged. Chemical precipitation can be used to remove soluble inorganics. Ion exchange and membrane technology are other good methods for separating soluble matter. Chemical oxidation includes such methods as incineration of dewatered organic sludges or liquids, wet air oxidation of organic bearing liquid sidestreams and the removal of small amounts of soluble organics by ozone. Whatever treatment system is decided on, it is necessary that a detailed cost analysis be performed and the total cost must be obtained so that it may be compared to other possible methods. Other techniques that are being considered for the future include incineration of soluble organics in liquids, catalytic oxidation, hydrolysis of organic sludges, and the use of magnesium carbonate for coagulation.

*Water reuse, *Waste water treatment, *Waste treatment, *Ultimate disposal, *Water treatment, Activated sludge, Organic matter, Activated carbon, Treatment, Trickling filters, Sands, Filtration, Dewatering, Treatment facilities, Ion exchange

D577
BROOKLYN PLANT MEETS MAJOR CHALLENGES,

Walter, C. R., and Lastihenos, J.

Hazen and Sawyer,
New York City, New York.

Water and Wastes Engineering, Vol. 12, No. 11, p 30-32, November, 1975. 1 fig.

The expansion of the Brooklyn, New York, 26th Ward Water Pollution Control Plant presented the challenges of limited site, close proximity to residences, and a short schedule. The purpose of the project was to increase the capacity of the existing plant from 60 to 85 mgd, and to increase BOD and suspended solids removal from 60% to greater than 90%. At the same time the plant was modernized, repaired, renovated, and, for systems that needed it, replaced. The total cost of the plant was approximately $43 million. The chief features of the modernization and expansion of the plant were a new screen building, new raw sewage pumps, the demolition of grit chambers, and the conversion of an area into a service and storage building. Scheduling and cooperation among all contractors was extremely important under the conditions of this particular job.

*Waste water treatment, *Sewage treatment, *Treatment facilities, Biochemical oxygen demand, Suspended solids, Costs, Construction

Renovation

D578
AWT PLANT IS TOP PERFORMER,

Peterson, W. A., and Sloan, B. J.

Metcalf and Eddy,
Boston, Massachusetts.

Water and Wastes Engineering, Vol. 12, No. 11, p 49-51, November, 1975. 1 fig, 3 tab.

The new Marlborough, Massachusetts, Easterly Advanced Wastewater Treatment Plant upgrades the quality of the effluent discharged to the Sudbury River. In the past, major water problems were excessive levels of duckweed and algal blooms due to the high phosphorus content of the effluent. The new facility removes phosphorus by chemical precipitation with alum added in the first stage aeration tank effluent channel. Studies indicated that with an aluminum to inorganic phosphorus ratio of 2.1 to one, a mean final effluent total phosphorus concentration of 0.36 results. The corresponding orthophosphorous concentration was 0.11 mg/liter and the total phosphorous removal efficiency was 94%. Total nitrogen removal through the plant was typically found to be 45%. The unit operations of the plant include comminution, grit removal, primary settling, two-stage activated sludge, chemical precipitation of phosphorous, chlorine disinfection, reaeration, and vacuum filtration with sludge disposal to an on-site sanitary landfill. The total cost of the construction of the facility was $6.2 million and the operating cost is 34 cents/1,000 gallons treated.

*Waste water treatment, *Chemical precipitation, *Tertiary treatment, *Aeration, Aluminum, Phosphorus, Nutrient removal, Eutrophication, Sludge disposal, Construction, Costs

D579
PLANT PROTECTS A RECREATIONAL LAKE,

Alley, E. R.

E. Roberts Alley and Associates,
Brentwood, Tennessee.

Water and Wastes Engineering, Vol. 12, No. 11, p 69-71, November, 1975. 1 fig.

When the Radnor, Tennessee, Water District's Hurricane Creek Wastewater Treatment Plant was to be expanded from 175,000 gpd to 875,000 gpd, the State Department of Public Health established strict criteria to protect the eutrophying Percy Priest Reservoir. In addition, the existing plant had to remain in service during construction, the expansion contract had to be awarded to a contractor within three months of the beginning of design, and since the project was being financed by an industrial park, the construction cost had to fall within a strict budget. To meet the tight design and approval schedule, final plans and specifications were produced within six weeks, advertisement for bids lasted 30 days, and final award was given within three months. Final plans on portions of the project were drawn while preliminary approvals were being obtained on others. Fewer change orders were needed and the final cost was lower than the bid. Since January, 1975, the average effluent BOD has been 3.2 mg/liter; the effluent suspended solids, 8.7 mg/liter; and the effluent ammonia, 0.6 mg/liter, all well within the limits. The NH3-N has been consistently reduced to 0.5 mg/liter when the influent TKN has ranged from 20 to 34 mg/liter. The total construction cost for the plant was $786,000.

*Waste water treatment, *Treatment facilities, Tennessee, Construction, Sewerage, Biochemical oxygen demand, Ammonia, Eutrophication, Lakes

D580
REGIONAL PLANT TREATS SEPTIC WASTES,

Katsura, Y.

Boyle Engineering,
Ventura, California.

Water and Wastes Engineering, Vol. 12, No. 11, p 81-82, 84, November, 1975. 1 fig, 1 tab.

The disposal of septic tank/cesspool and chemical toilet wastes had become critical in the area of Ventura, California, due to the inability of many local waste water treatment facilities to accept those wastes and the continued disposal of the wastes on fields and ravines. The chlorine stabilization process was selected for treatment of the wastes because of its ability to achieve liquid/solid separation along with stabilization. After concentration and separation, the solid fraction is trucked to landfill and the liquid fraction is piped to the ocean. The liquid waste processing capacity of the facility is 65,000 gpd. The process consists of a receiving station and wet well, a transfer station, a degritter, a solids balancing/storage tank, solids feed pumps, solids conditioning units, solids concentration and decant storage ponds, an effluent pump station, a decant neutralization facility, and appurtenant support facilities. To stabilize the liquid waste, several factors had to be balanced, including chlorine dosage and percent solids of feed. The next critical step was solids concentration for which a unique decanting method produced a solids concentration of 17.8%. The total cost of the facility was $950,000, of which about 87% was paid for by federal and state grants.

*Waste water treatment, *Septic tanks, *Municipal wastes, *Treatment facilities, Chlorine, Liquid wastes, Costs

D581
SUPERNATANT DOESN'T HAVE TO RUIN EFFLUENT QUALITY,

Sampayo, F. F.

Jones and Henry Engineers, Limited,
Toledo, Ohio.

The American City and County, Vol. 90, No. 11, p 52-53, November, 1975. 1 tab.

In order to produce high-quality effluents, a new method for treatment of supernatant and filtrate is being tried in Pontiac, Michigan. The process strips ammonia under high temperature and pH conditions while minimizing chemical requirements and unpleasant odors of ammonia. By this process BOD and suspended solids loading on the plant processes are also reduced. The ammonia stripping tank is a 12-ft diameter, 18.5-ft high fiberglass tank equipped with a bottom air header and diffusers. The tank is totally enclosed to eliminate stray ammonia odors. The process should reduce the NH3-N concentration in the recycle streams to 100 mg/liter or less, as well as remove substantial amounts of BOD and suspended solids. Air requirements for the activated sludge process can be reduced and a more stable plant operation is possible. The cost for power for stripping the ammonia is minimal.

*Waste water treatment, *Activated sludge, *Odor, Biochemical oxygen demand, Costs, Effluents, Filtration, Suspended solids

Ammonia stripping, Supernatants

D582
OLD SLOW SAND + NEW RAPID FILTRATION,

Thompson, J. C.

Water and Sewage Works, Vol. 122, No. 11, p 78-80, November, 1975. 4 fig.

In the new rapid sand filtration plant in Springfield, Massachusetts, the conventional sedimentation stage preceding filtration was eliminated because of the good quality of water from Little River. After conducting comprehensive studies, an environmental engineering firm determined that sedimentation could be eliminated when a chemical was used for coagulation of solids during filtration. This resulted in a savings of $2.5 million for the city. The new plant consists of influent metering and flow diversion works, mixing and conditioning basins, dual-media filters, wash water storage and pumping facilities, and a control building that houses the new laboratory facilities. It has a capacity of 60 mgd and could be expanded to 180 mgd. After tests were run to compare the performance of alum and polymer as coagulants in the filtration process, it was found that both worked equally well and polymer was cheaper than alum. Since the beginning of operation in November, 1975, the plant has been operating using a cationic polyelectrolyte at a dosage of about 1.4 to 1.5 mg/liter at filtration rates on the order of two to three gpm/sq ft. The filters have been routinely operated for one week between backwashes. No filter has yet shown excessive head loss or break-through of turbidity while continuing to deliver water of excellent quality.

*Sedimentation, *Filtration, *Water treatment, Treatment facilities, Control systems, Polymers, Polyelectrolytes, Filters, Turbidity

Alum

D583
ENGINEERS CAN EXERT PROCESS CONTROL OVER DIGESTER INPUTS,

Mignone, N. A.

Water and Sewage Works, Vol. 122, No. 11, p 51-53, November, 1975. 3 fig, 1 tab, 2 ref.

Anaerobic digestion can be controlled better by using a dissolved air flotation thickener instead of a gravity thickener. Many of the problems associated with anaerobic digestion of combined primary and waste activated sludge can be attributed directly to hydraulic overload which causes reduction in digester operating temperature, washout of organisms and dilution of system buffering capacity. If a dissolved air flotation thickener is placed immediately before the anaerobic digestion system, hydraulic overload can be prevented and the operation of the system will be vastly improved. Another feature of the dissolved air flotation unit is its function as a secondary grit removal facility. It can also produce a thicker combined sludge, thus allowing for smaller downstream equipment, meaning less capital and maintenance cost compared to past systems. Development work is being undertaken to automate the dissolved air flotation unit process in order to maintain the desired solids concentration under the various expected inflow conditions.

*Anaerobic digestion, *Activated sludge, Hydraulics, Equipment, Kinetics, Waste water treatment, Costs

Thickening, Waste activated sludge

D584
MUNICIPAL WASTEWATER ODOR STILL A PROBLEM--PART 1,

Hartman, W. J., and Long, D. A.

Water and Sewage Works, Vol. 122, No. 12, p 38-41, December, 1975. 2 fig.

Odors associated with collection, transport, treatment, and disposal of sludge and waste water effluents are a form of air pollution related to municipal waste water treatment. Odors can come from the vapors and gasses produced by the anaerobic decomposition of compounds, or they can be the result of chemicals in industrial waste. Algae, an important waste stabilizer, can also be a source of odors. Preventing water from stagnating and skimming algal overgrowth are two solutions to the problem. Careful separation of solids is another minimizing solution. Two other problems related with municipal waste water, insect breeding and pathogen dissemination, are also discussed.

*Odor, *Municipal wastes, *Waste water treatment, Waste water disposal, Air pollution, Anaerobic treatment, Industrial wastes, Algae

D585
POND AND IRRIGATION SYSTEMS OFFER ECONOMY AND FLEXIBILITY,

Williams, T. C.

Water and Sewage Works, Vol. 122, No. 12, p 44-45, December, 1975.

Oxidation pond and irrigation waste water systems, especially suited for small communities, are "natural" systems requiring little maintenance. The oxidation ponds or stabilization lagoons need to be checked once a day. The irrigation system is usually one of three systems: spray, flood, or ridge and furrow. The spray system with center pivot equipment is the most widely used in the United States. Crops ranging from alfalfa to Christmas trees are often grown in conjunction with the irrigation system. An especially attractive feature of pond and irrigation systems is that they can be developed in stages with low initial costs.

*Oxidation lagoons, *Waste water treatment, *Irrigation, Waste water disposal, Crop production, Capital costs, Economics

Oxidation ponds, Spray irrigation

D586
DESIGN AND OPERATION OF HIGH-RATE FILTERS--PART 3,

Kawamura, S.

James M. Montgomery, Consultant Engineers, Incorporated,
Pasadena, California,
Water Treatment Division.

American Water Works Association Journal, Vol. 67, No. 12, p 705-708, December, 1975. 2 fig, 3 ref.

The hydraulics on the backwash system of high-rate filters are computed and discussed. Wash-water troughs and underdrainage systems of the American fluidization back-wash and the European air-scour back-wash filter system are explained and compared. The author mentions his own experimental development of a new type of filter bottom, but adds that in most cases there is little opportunity for experimental studies. The entire discussion and recommendations are addressed to the designer of filters.

*Hydraulics, *Filters, *Waste water treatment, *Water treatment, *Design criteria, Filtration, Research

*Backwash, *High-rate filters

D587
DESIGN AND OPERATION OF HIGH-RATE FILTERS -- PART 2,

Kawamura, S.

James M. Montgomery, Consultant Engineers, Incorporated,
Pasadena, California,
Water Treatment Division.

American Water Works Association Journal, Vol. 67, No. 11, p 653-662, November, 1975. 10 fig, 12 ref.

The design of high-rate filters is mostly related to the physical factors of the filter-washing process, the process by which water flows upward through filter media particles. The major factors of the filter-washing process are size and specific gravity of filter media; type and arrangement of filter underdrain system; number, size, and location of wash-water troughs; size and elevation of the wash-water tank, or capacity and head of the wash-water pumps; backwash rate-control system; and type and capacity of auxiliary scour. Of the three basic types of filter-washing processes, the fluidized filter bed is used in the United States, the air-scour wash is practiced in Europe, and the third is a combination of the other two. The article discusses various aspects of filter washing, including appropriate backwash rates.

*Filters, *Design criteria, *Wash water treatment, *Water treatment, Filtration, Flow control, Flow rates

*High-rate filters, Backwash, Filter media

D588
PHOSPHORUS REMOVAL FROM STATIC SEWAGE EFFLUENT USING DUCKWEED,

Sutton, D. L., and Ornes, W. H.

University of Florida, Agricultural Research Center,
Fort Lauderdale.

Journal of Environmental Quality, Vol. 4, No. 3, p 367-370, September, 1975. 4 fig, 1 tab, 12 ref.

Aquatic macrophytes have been used to remove nutrients from sewage effluents. In this case, duckweed (Lemnaceae family) was suggested for the removal of phosphorus and experiments were conducted to determine the amount of plant material and length of time necessary to reduce the nutrient level in enriched water. The level of production of plants that could be expected when plants are harvested was also investigated. A mixed population of duckweed was grown for two weeks in 12 liters of 16, 12, and 25% concentrations of secondary treated sewage effluent; the dry weights of these plants were 16, 23, and 31% higher than plants grown in pond water. Over 90% of the phosphorus in the sewage effluent was removed by the duckweed during the first four weeks of an eight week period; during the second four weeks removal was slow. For the whole period, the phosphorus content of the sewage effluent was reduced from 2.67 to 0.08 micrograms/ml, a 97% decrease. The conclusions of the study were that duckweed could be used to reduce levels of phosphorus in sewage effluent held under static conditions. The removal rate depended upon the amount of duckweed, concentration of phosphorus in the effluents, and length of contact time.

*Sewage effluents, *Nutrient removal, *Waste water treatment, Phosphorus, Effluents, Aquatic plants, Tertiary treatment

*Duckweed, *Phosphorus removal

D589
PROCESS BIODEGRADABLE EFFLUENT UNDERGROUND,

Processing, p 33, September 1975. 2 fig.

One of the few "spin-off" technique effluent treatment operations is the ICI Deep Shaft Aeration Process at Billingham. The process is a combination of activated-sludge and aerobic-digestion systems located in a mined shaft hundreds of feet deep. Because of the pressure resulting from the great depth of the shaft the air bubbles disappear before reaching the bottom of the shaft, and all the dissolved oxygen is available to the process, thus reducing the normal retention time from 12 hours to 2 hours. The biodegradable effluent and microorganisms are circulated by compressed air until the biological oxidation is complete, when it overflows by gravity for solids separation. Some of the advantages over conventional systems are 50% land savings due to eliminated settling stage, 50% less sludge production, low capital and operating costs, and minimal environmental impact.

*Biological treatment, *Waste water treatment, *Aeration, Activated sludge, Biodegradation, Costs, Environmental effects

*Deep shaft process

D590
WASTEWATER RENOVATION AND REUSE: AN URGENT ENVIRONMENTAL NEED,

D'Itri, F.

Compost Science, Vol. 16, No. 5, p 26-27, Autumn, 1975.

Thirteen recommendation were made by the International Conference on the Renovation and Recycling of Wastewater Through Aquatic and Terrestrial Systems. The representative scientists from nine countries at the July, 1975, meeting exchanged information on reuse technology, discussed the possibilities of use of waste water, and examined the social impacts of waste water reuse in various countries. They then drew up the program of recommendations which included the demand for control of all varieties of industrial waste, the recommendation that no sludge be used resulting in direct human consumption, and the request that detailed consideration be given to the actions of heavy metals, biocides, teratogens, carcinogens, mutagens, and all varieties of pathogens.

*Waste water treatment, *Recycling, *Water reuse, Industrial wastes, Sludge disposal, Conferences

D591
MUNICIPAL PLANT HANDLES 44% PULP AND PAPER MILL WASTES,

Swope, H. G.

Water and Sewage Works, Vol. 122, No. 12, p 61, December, 1975.

The Green Bay Sewage Treatment Plant is the first plant in Wisconsin that handles municipal sewage containing 44% pulp and paper mill wastes. The plant, which represents a partnership of public and private sectors, was designed to meet the district's projected waste water treatment needs until at least 1990. The operating costs of the facility will be $1 million annually. The sewage at the Green Bay plant undergoes mechanical treatment, biological treatment, and solids processing. The sludge is incinerated and the ash deposited on landfill. As of the end of 1975, part of the facility was still under construction. The project was expected to cost approximately $72 million and was designed to handle a peak flow of 171 mgd.

*Sewage treatment, *Municipal wastes, *Pulp and paper industry, *Wisconsin, Treatment facilities, Operating costs, Incineration, Biological treatment

Municipal-industrial wastes

D592
REVERSE OSMOSIS PLANT HELPS CITY COPE WITH DIMINISHING GROUNDWATER SUPPLY,

Dacy, G. H.

G. H. Dacy Associates, Incorporated,
Miami, Florida.

Water and Sewage Works, Vol. 122, No. 12, p 70-73, December, 1975. 2 fig, 2 tab.

Diminishing supplies of groundwater forced the city of Venice, Florida, to consider alternate water sources. After considering various possibilities, the city chose a reverse osmosis plant that would draw on a supply of brackish water in the Upper Tampa/Lower Hawthorne strata. The supplier of the plant, Polymetrics, must test the plant and then install it in the city's new facilities. The Polymetrics reverse osmosis plant has membranes of eight inch duPont hollow fiber Permasep permeators that produce a nominal initial 14,000 gpd of desalted water per permeator. The primary elements of this system are well pumps, 5-micron prefilters, hex and acid injection pumps, high pressure pumps, permeators, reverse osmosis blocks and stages, block flow controllers, degasifier, product transfer pump and valve, permeator cleaning system, and electrical controls and instruments. The projected costs of 43.8¢/1000 gal of finished water are tabulated.

*Groundwater, *Water supply, *Reverse osmosis, Water treatment, Municipal water, Florida, Pumps, Valves, Equipment, Costs, Water sources, Brackish water

D593
TORONTO'S APPROACH TO PREVENTIVE MAINTENANCE FOR TREATMENT PLANTS,

Baldock, E. H.

Metropolitan Toronto Department of Works,
Toronto, Ontario, Canada,
Water Pollution Control Division.

American Water Works Association Journal, Vol. 16, No. 11, p 614-616, November, 1975. 1 fig.

Toronto's new program for preventive maintenance of treatment plants employs a computer to administer the program. In order to prepare the computer, all the equipment of the vast plants had to be reinventoried, renumbered, and reviewed. A numbering system for all equipment, with provisions for additions, replacements, and exchanges, had to be devised. Initial data had to be collected on computerized forms. Processes and maintenance cycles had to be recorded. With the data supplied to the computer, it will print out, on a weekly basis, the list of components to be serviced at each plant for each week. The computer work order will list the component identification number, the level of maintenance required, a list of tools required for the function, and an estimated number of man-hours required for the task. A report of all work done will be stored in the computer. The article details the coding system used by the Toronto Department of Works.

*Computers, *Equipment, *Waste water treatment, *Water treatment, *Maintenance, Treatment facilities, Data collections

Toronto (Ontario), Coding system

D594
OPERATIONAL PRACTICES TO UPGRADE TRICKLING FILTER PLANT PERFORMANCE,

Shriver, L. E., and Bowers, D. M.

Henningson, Durham and Richardson, Incorporated,
Omaha, Nebraska.

Journal Water Pollution Control Federation, Vol. 47, No. 11, p 2640-2651, November, 1975. 9 fig, 2 tab, 9 ref.

An investigation of trickling filter plant performance was conducted to discover the reasons for clarifier inefficiencies in winter and to find ways to improve effluent quality in winter. Samples of final effluent were tested and chemical coagulation was done by jar tests at typical wintertime temperatures. Of the various chemical coagulants tested, detailed reports on the coagulant alum were made because of reports of success at many treatment plants. It was found that the terminal settling velocity of a particle with a given size and density decreases with a decrease in temperature. Adding alum to the trickling filter effluent upgraded plant performance and increased sludge volumes, but digester operation must be watched more closely. Several recommendations for improving plant operation in winter were made. Waste water temperature variations should be considered in final clarifier surface loading design. When adding chemicals, mixing, recirculation flows, freezing, and corrosion are important considerations. Separate chemical treatment for digester supernatant and/or high-strength in-plant waste streams should be considered at plants in which the impact of this waste is significant.

*Trickling filters, *Waste water treatment, Biological treatment, Clarification, Coagulation, Treatment facilities

Alum, Chemical treatment

D595
WATER FACTORY 21 IS THE FUTURE,

Mills, W. R., and Ewing, L. J.

Toups Corporation,
Santa Ana, California.

Water and Wastes Engineering, Vol. 12, No. 11, p 34-36, November, 1975. 1 fig.

Water Factory 21 is the first of a kind which injects a combination of desalted seawater and reclaimed waste water into the groundwater basin for domestic use. The combined capacity of 30 mgd will provide for the water needs of one tenth of Orange County, California, residents while providing the necessary design, construction, and operating technology for the future development of water supply factories. In addition, Water Factory 21 supplies the 30,000 acre-feet of water necessary to create an effective fresh water barrier against seawater intrusion. The factory is made up of three separate facilities, a desalting plant, a waste water reclamation unit, and an underground basin. Present estimates indicate that costs of operation of Water Factory 21 will range from 32 to 38 cents per 1,000 gallons, a price comparable to the anticipated costs of supplying water from other sources. The facility recycles water and creates an easily expandable water source.

*Water treatment, *Water reuse, *California, *Water supply, Costs, Treatment facilities, Waste water treatment, Groundwater, Recharge, Saline water barriers

Water Factory 21

D596
DESIGN, OPERATION, AND MONITORING OF MUNICIPAL IRRIGATION SYSTEMS,

Malhotra, S. K., and Myers, E. A.

Williams and Works, Incorporated,
Grand Rapids, Michigan.

Journal Water Pollution Control Federation, Vol. 47, No. 11, p 2627-2639, November, 1975. 3 fig, 3 tab, 21 ref.

Land disposal systems for municipal waste water provide a system with simplicity and low operating and maintenance costs. The various land disposal systems under construction or currently in operation in Michigan are continuously dosed seepage, intermittently dosed seepage, flood irrigation, ridge and furrow irrigation, solid set spray irrigation, traveling sprinkler spray irrigation, and center pivot sprinkler spray irrigation. Generally, the need for secondary treatment and winter storage has led to the use of oxidation ponds. Irrigation rates are detailed for hydraulic loading, organic loading, nitrogen loading, and phosphorous loading. Of the three most commonly used irrigation systems — flooding, ridge and furrow, and spraying — flooding is best for flat and expensive land, ridge and furrow for flat land with medium to heavy soils, and spraying for steeply sloping sites. Farmers prefer spray irrigation for proper and effective crop management. Perennial grasses are the most popular crops, but corn is being grown at some sites successfully. To date none of the irrigation systems in Michigan has been found to result in a significant degradation of the chemical or bacteriological quality of the groundwater in its surrounding areas. Groundwater quality data from some of the systems in operation are listed in tables.

*Irrigation, *Waste water disposal, Operating costs, Tertiary treatment, Hydraulics, Michigan, Groundwater quality

Land disposal

D597
ANAEROBIC DIGESTION: THE RATE-LIMITING PROCESS AND THE NATURE OF INHIBITION,

Finney, C. D., and Evans, R. S.

Drake University,
Des Moines, Iowa,
Department of Physics.

Science, Vol. 190, No. 4219, p 1088-1089, December 12, 1975. 1 fig, 1 tab, 21 ref.

Anaerobic digestion would hold much greater promise if faster processes could be developed. One hypothesis is that the transfer of acetic acids by methanogenic bacteria into methane and carbon dioxide gases is rate-limiting, and that the normal metabolic activity of the methanogenic bacteria is inhibited by product gases. It is possible that at very high substrate concentrations gas bubbles actually surround a bacterium, interfering with substrate diffusion into intracellular spaces. An experiment for determining the kinetic parameters of the methanogenic bacteria in a highly mixed, low-pressure environment, resulted in improved gas transfer characteristics in the region of the bacterial cell wall. The indication is that faster, more efficient anaerobic digesters might be developed. Design specifications for faster systems might include vigorous agitation, low pressure, and elevated temperatures.

*Anaerobic digestion, *Waste water treatment, *Bacteria, Methane, Carbon dioxide, Kinetics, Design criteria, Inhibition

D598
LIME RECOVERY AND REUSE IN PRIMARY TREATMENT,

Parker, D. S., Carthew, G. A., and Horstkotte, G. A.

Brown and Caldwell,
Walnut Creek, California.

Journal of the Environmental Engineering Division-ASCE, Vol. 101, No. EE6, p 985-1004, December, 1975. 8 fig, 7 tab, 7 ref.

The lime recovery and reuse study, part of the research undertaken by the Central Contra Costa Sanitary District of California, was conducted in order to provide design and operating data on the various unit processes being designed for the district's new water reclamation plant. The study investigated the solids processing and recycling operations and monitored the performance and interaction of the individual unit processes under recycle conditions. Sampling and analysis of the constituents of each stage of the solids processing system allowed determination of amounts of calcium, magnesium, phosphorus, iron, silica, available lime, total solids, and loss on ignition. Daily logs were devised so that, along with laboratory data, calculations could determine the performance of the recycle process. It was found from the investigation that recalcined lime performed better than the virgin lime in primary treatment applications. Calcium carbonate and, to a greater extent silica, are classified into the cake in the wet classification process. Recalcination efficiency was dependent on recalcination temperature. A rejection of 24% of the silica, while recovering 98% of the calcium oxide, is possible in the dry classification process. Mass balances for the full-scale system indicate that 62% recycle of lime is possible while keeping recycled solid loads at reasonable levels.

*Lime, *Recycling, *California, *Water reuse, Monitoring, Design, Sampling, Treatment facilities, Water treatment

Unit processes

D599
LOW COST PHOSPHOROUS REMOVAL,

Peirano, L. E.

Water and Sewage Works, Vol. 122, No. 11, p 58-59, November, 1975.

The PhoStrip process was studied in a plant-scale test at the Reno-Sparks Joint Water Pollution Control Plant that treats approximately 6 mgd of domestic waste water. The PhoStrip process utilizes activated sludge microorganisms to concentrate phosphorous from the waste water flow stream into a smaller stream from which the phosphorous is removed by chemical precipitation. The major difference between the PhoStrip process and other biological processes for phosphorous removal is the use of a separate phosphorous stripping tank where phosphorous release is induced and controlled. An equation for phosphorous removal efficiency is given as E = 100 - 130 to the (1.85-P) powe., where E stands for phosphorous efficiency and P stands for a composite parameter. During the study it was noted that the PhoStrip process produced more stable sludge than conventional systems, and that it had no significant effects on BOD or suspended solids removal or on aeration air requirements. The PhoStrip was also less affected by shock loads because of the offstream reservoir of activated sludge provided by the stripping tank. The system did produce more froth than the conventional system, and some odor emanated from the stripping tank. The PhoStrip process achieved greater than 90% removal of phosphorous, and at the Reno-Sparks plant will save an estimated $600,000 to $800,000 annually in operation and maintenance costs.

*Activated sludge, *Chemical precipitation, *Waste water treatment, Nutrient removal, Phosphorus, Equipment, Costs, Biological treatment

PhoStrip process, Phosphorus removal

D600
COMBINED WASTE TREATMENT PROVES ECONOMICAL AND FEASIBLE,

Hannigan, J. T.

Whitman and Howard, Incorporated,
Boston, Massachusetts.

Water and Sewage Works, Vol. 122, No. 11, p 38-41, November, 1975. 1 fig, 3 tab.

Results of a pilot plant study have shown that combined treatment of domestic waste and industrial cranberry waste is the most economical way to treat both waste waters in the town of Middleborough, Massachusetts. The municipal plant presently treats the cranberry industry's waste, but due to plant expansion, population growth, and equipment wear, a new treatment facility is necessary. The study showed that the cost of constructing a tertiary treatment facility to handle both domestic and industrial cranberry waste is almost 1.5 million dollars less than the cost of a tertiary treatment facility for the domestic waste water alone. The results of the study also showed that the cranberry waste is substantially biodegradable and the mixture of both domestic and industrial resulted in the BOD rate constant approaching that of the cranberry facility's waste water alone. Biological treatment of the combined wastes, in which the domestic wastes will take advantage of the nutrient deficiencies of the industrial waste, should achieve excellent BOD removal as well as a reduction in the overall phosphorus and ammonia nitrogen concentration. The proposed facility will include a pretreatment facility, two primary clarifiers, four aeration tanks, two secondary clarifiers, a post chlorination detention tank, a sludge handling and chlorination building, a sludge holding tank, a new control building, two rapid sand filters and a post aeration tank. Construction of the project, estimated to cost $4.5 million, began in 1975 and is projected to be completed in 1977.

*Pilot plants, *Food processing industry, *Waste water treatment, Municipal wastes, Tertiary treatment, Treatment facilities, Biochemical oxygen demand

Combined municipal-industrial wastes

D601
CROSS-FLOW FILTRATION AND AXIAL FILTRATION,

Kraus, K. A.

Oak Ridge National Laboratory,
Oak Ridge, Tennessee.

In: Proceedings of the 29th Industrial Waste Conference, Part Two, May 7-9, 1974, Lafayette, Indiana, Purdue University, p 1059-1075. 13 fig, 3 tab, 34 ref.

Increasing effluent standards are making presently adequate treatment methods unsatisfactory. Alternative, more efficient solid-liquid separation techniques are needed. Two novel forms of filtration, cross-flow filtration and axial filtration, are discussed. Cross-flow filtration is the technique whereby the feed solution is rapidly pumped past the filtering solution at right angles to product flow. Cross flow filtration is carried out at low pressures and deals with the removal of particulates and colloids, and so must be differentiated from hyperfiltration and ultrafiltration. Axial filtration depends on the idea that pumping a solution past a filter is no different from passing a filter through a solution. The filter rotates about a hollow cylinder and, at high rotational velocities, filtration is augmented by high centrifugal forces. Various design options for the two types of filter are discussed. Axial filters can be used in different modes of operation, depending on the rotational velocities. The object of both types of filtration is to produce flow speeds such that the flux decline as a function of time is arrested. A mathematical analysis of flux decline is presented. An economical analysis of the filters is given. For cross-flow filters, energy requirements per unit product are inversely proportional to production rate for a constant cross-flow velocity. For a constant energy consumption, cross-flow velocities increase with production rate. Axial filters can become uneconomical when dealing with extremely small particles, since very high rotational speeds are required to arrest flux decline. Various applications of these designs are illustrated.

*Filters, *Filtration, Waste water treatment, Effluents, Colloids, Design, Equipment, Analytical techniques, Separation techniques, Centrifugation, Energy, Economics

*Axial filtration, *Cross flow filtration, Particulate matter, Flux decline

D602
TERTIARY TREATMENT PLANT FOR MULTISTORIED BUILDING,

Savalappan, K. N.

Dorr-Oliver (India) Limited, Madras.

Journal of the Institution of Engineering (India), Vol. 55, Part PH3, p 81-84, June, 1975. 1 fig, 2 tab.

Modern technology has resulted in large concentrations of people in India and, consequently, an increase in the number of multistoried buildings. Bombay, which contains many of these buildings, has an acute water scarcity. Tertiary treatment, which makes sewage fit for reuse, is discussed as a technique to increase the water supply for multistoried buildings. Water is lost through domestic use and, although water used for air conditioning units can be reused after cooling, a certain amount is lost through evaporation. Tertiary treatment plants were installed to make toilet water fit for reuse as cooling water in air conditioning units. A flow sheet of a tertiary treatment plant is illustrated. Sewage is brought from the building and large floating matter is filtered with a bar screen. The activated sludge process is used in the aeration tanks to purify the raw sewage. The biochemical oxygen demand of the effluent from this tank is monitored. The aerated sewage flows into a clarifier where the biological solids are separated and returned to the aerator. Coagulants are added and the effluent is flocculated and further clarified. The effluent undergoes rapid sand gravity filtration and is softened in a regeneration unit by means of a cation exchange process. The final step is chlorination, to prevent algal growth. Costs may vary over a considerable range, but the apparatus, methods and processes exist to produce water of virtually any purity required.

*Treatment facilities, *Tertiary treatment, Waste water treatment, Activated sludge, Sewage, Aeration, Effluents, Buildings, Water reuse, Biochemical oxygen demand, Separation techniques, Costs

*Multistoried buildings, Bombay (India), India

D603
WASTEWATER TREATMENT EVALUATION, MT. HEBO AIR FORCE STATION, OREGON,

Pauls, C. F.

Environmental Health Laboratory,
McClellan Air Force Base, California.

February, 1975. 72 p, 6 fig, 12 tab, 8 ref. ADA 009 471.

Samples from Mt. Hebo's site and housing area domestic waste water treatment facility were analyzed and compared with the standards of the National Pollutant Discharge Elimination System issued by the EPA. Each treatment facility's performance was compared with predicted performance standards based on design equations or with standard practice. Results of chemical and bacteriological analyses are given in tables and discussed in detail in the article. The effluent from the site and housing treatment facilities did not meet the national standards, so recommendations were made for improving existing facilities. These recommendations include repairing the secondary clarifier at the site treatment facility that was ineffective at the time of testing, modifying the conveyance system at the housing area facility, and improving the trickling filter. It was also suggested that better maintenance and operational control could improve plant efficiency at both locations. Automated equipment for monitoring effluent is being considered for the facilities. Secondary effluents from the facilities can be applied to the soil and infiltrated into the ground as no undesirable affects can be foreseen.

*Waste water treatment, *Treatment facilities, *Biological treatment, *Trickling filters, Municipal wastes, Water quality control

D604
SINGLE STAGE NITRIFICATION-DENITRIFICATION,

Bishop, D. F., Heidman, J. A., and Stamberg, J. B.

EPA-DC Pilot Plant,
Washington, D.C.,
Department of Environmental Services.

June, 1975. 28 p, 5 fig, 8 tab, 15 ref. PB 242 857.

From 75 to 84 percent of nitrogen was removed from primary waste waters in a newly developed single stage activated sludge process at the EPA-DC pilot plant in Washington, D.C. A two-pass biological reactor removed the nitrogen by means of a dissolved oxygen concentration that varied from 0 to 3 mg/liter. Nitrification occurred when the dissolved oxygen level was at 2 or above, and denitrification occurred at a level of around zero. The amount of nitrogen removed was controlled by the COD/TKN ratio in the waste water entering the reactor. Increases in the COD/TKN ration could possibly increase nitrogen removal. Laboratory kinetic studies on the mixed liquor solids showed that the denitrification kinetic rate controlled the reactor design. Nitrification rates remained the same during repetitive aerobic-anaerobic cycles, but the denitrification rates dropped as the residual carbon was consumed by the biological reactions. The advantages of this nitrification-denitrification process are that the volume of air needed to achieve nitrification and BOD removal is reduced, and the organic carbon needed for denitrification is minimized. Intermediate clarifiers and the recycling process were eliminated. Tables of data on the various conditions and results of the two-stage system are included in the report.

*Pilot plants, *Nitrification, *Denitrification, Chemical oxygen demand, Biological treatment, Kinetics, Waste water treatment, Treatment facilities, Activated sludge

D605
REPLACEMENT OF ACTIVATED SLUDGE SECONDARY CLARIFIERS BY DYNAMIC STRAINING,

Joyce, M., Schultz, W., and Strom, A.

FMC Corporation,
Itasca, Illinois,
Environmental Equipment Division.

May, 1975. 75 p, 18 fig, 27 tab, 4 ref. PB 242 828.

To determine the feasibility of replacing conventional activated sludge gravitational clarifiers by dynamic straining, pilot plant studies were conducted. Consisting of a rotating cylinder cleaned by an internal ultrasonic transducer, two dynamic strainers were placed, one in the aeration tank and the other in a separate tank. The single primary strainer operating in the aerator achieved suspended solids removals of over 99 percent in a solids concentration of 6,500 mg/liter. Primary straining appeared to be capable of consistently producing an effluent suspended solids in the 15/30 mg/liter range when operated at lower specific flow rates. This work indicated that dynamic straining is technically feasible but equipment would cost more than the conventional clarifiers. Several advantages of the dynamic strainer could outweigh the cost factor: it takes less space, secondary gravity clarifiers could be eliminated, and aeration tank sizes could be decreased. An existing activated sludge plant could be upgraded without expanding facilities by adding only a dynamic strainer. In locations or applications where filamentous growth is prevalent, primary straining could be used to control bulking. Dynamic straining also revealed itself to be resistant to shock loading.

*Pilot plants, *Clarification, *Aeration, *Activated sludge, Straining, Waste water treatment, Suspended solids, Treatment facilities

Dynamic straining

D606
AN EVALUATION OF THE USE OF GAMMA RADIATION IN SEWAGE TREATMENT,

Bonhote, P. A., Clouston, J. G., Ford, G. W. K., and Gregory, N. J.

Australian Atomic Energy Commission
Research Establishment,
Lucas Heights, Australia.

December, 1974. 2 fig, 2 tab, 6 append. AAEC E-330.

A critical assessment of sewage treatment with gamma radiation was made by the Australian Atomic Energy Commission Research Establishment. The assessment was undertaken in response to a claim made by Energy Systems Incorporated of Florida that cobalt-60 irradiation was advantageous in recovering sewage water. The subject was considered for cost factor, the physical and chemical effects of radiation for purification and recovery of waste water, and for radiation effects on the microbiology of waste water. To date there is little literature indicating significant contributions to sewage recovery methods by irradiation. Statements on the lethality of irradiation to viruses are not substantially validated. The coliform count is not an indicator of effective sewage treatment and can be misleading. The irradiation dose of 100,000 rad is not adequate and a significant dose increase would be necessary. Irradiation has no significant effect on the degradation of pesticides and detergents. In sum, irradiation methods have at present no cost advantage, no proven technical advantage and no proven biological advantage over known treatment systems and may have a psychological disadvantage owing to the still prevalent public suspicion of all things associated with ionizing radiation.

*Sewage treatment, *Gamma rays, *Costs, *Waste water treatment, Coliforms, Biodegradation, Australia

D607
NITRATE REMOVAL FROM WATER BY ION EXCHANGE,

Gauntlett, R. B.

Water Treatment and Examination, Vol. 24, Part 3, p 172-193, 1975. 5 fig, 5 tab, 13 ref.

Methods and results of nitrate removal from water with commercially available resins producing ion exchange are discussed in this paper. Effort has been directed towards developing a resin specific for nitrate in preference to all other common anions found in potable waters including sulfate. For use in testing the continuous ion exchange loop system, resins R and S were used to obtain a conservative estimate of resin performance. In the continuous loop, resin is moved physically from the section where it is regenerated around to the treatment section where it becomes exhausted. From there it is moved around to re-enter the regeneration section, thus both steps occurring simultaneously and continuously. The loop was studied for the effect of the regenerant dose and the effects of the resin circulation rate. A good compromise between regeneration efficiency and nitrate removal was attained by using a dose rate of 0.75 g/min of salt in the water. The continuous loop was then compared with a fixed bed operation and it was found that both systems gave equal nitrate removal, but the continuous loop produced water with a higher alkalinity and a lower chloride content. Ion exchange, as a method for removing nitrate from water, is a feasible method for giving acceptable water. Whether it will be economical compared with other nitrate-removal methods is not yet known.

*Ion exchange, *Nitrates, *Water treatment, *Groundwater, *Resins, Potable water, Nutrient removal, Economics

Nitrate removal

D608
WASTEWATER TREATMENT EVALUATION, MATHER AIR FORCE BASE, CALIFORNIA,

Pauls, C. F.

McClellan Air Force Base, California,
Environmental Health Laboratory.

June, 1974. 91 p, 5 fig, 21 tab, 13 ref. ADA 010 872.

In order to apply for a discharge permit from the EPA under the terms of the National Pollutant Discharge Elimination System, a survey was conducted of the waste water treatment facilities at Mather Air Force Base in California. The survey required samples to be taken from the effluent lines of the oil separators serving the aircraft and AGE washracks, from each of the plant units, and from the effluent sewer serving the metal cleaning and plating operation. The samples were analyzed for factors including alkalinity, BOD, COD, presence of solids, oil and grease, phenols, pesticides, and phosphates. Complete lists of analyses, methods, and results are given in tables. The discharge from the treatment plant, the polishing pond, and the drainage ditch met national standards. The first stage of the treatment facility did not provide sufficient reduction on BOD, SS, or fecal coliform organisms to provide secondary treatment according to EPA standards. Discharge from an inoperative lift station and overflow lines and underdrains from the oil separators were both sources of uncontrolled water pollution and required modification. Suggestions were made for improvement of the treatment facilities, of the drainage systems, and of equipment operation. It was also recommended that maintenance be improved and a maintenance program be developed.

*Waste water treatment, *Treatment facilities, *Surveys, Effluents, Biochemical oxygen demand, Water quality control, Maintenance, Equipment

National Pollutant Discharge Elimination System (NPDES)

D609
CARBON WASTEWATER TREATMENT PROCESS,

Public Works, Vol. 107, No. 2, p 62-63, February, 1976. 1 fig.

A method has been developed for the recycle of sewage sludge, in which the solids are upgraded in value by processing to an activated carbon, which is then used to purify the water from which they were removed. In a pilot plant test, sludge solids were effectively extracted and dewatered without the aid of coagulants. The solids were converted to an activated carbon in a pyrolysis reactor and showed removal characteristics equal to or better than commercial carbons. The newly produced carbon could then be used to promote separation of settleable and suspended solids from the sewage and to remove dissolved solids from the water. The potential of this system to meet or exceed both federal and state requirements for water disposal quality was also demonstrated.

*Sewage sludge, *Recycling, *Waste water treatment, *Sewage treatment, *Activated carbon, Dewatering, Separation techniques, Water quality control, Pilot plants

Pyrolysis

D610
CATHODIC INNER AND OUTER PROTECTION FOR A DOUBLE SYPHON FOR WASTE WATER (KATHODISCHER INNEN- UND AUSSENSCHUTZ FUER EINEN ABWASSER-DOPPELDUEKER),

Paulekat, F., and Schapp, H.

Die Bautechnik, Vol. 52, No. 9, p 305-311, September, 1975. 16 fig, 6 ref.

A new double waste water siphon installed underneath the Rhine-Herne Channel in West Germany, and its cathodic inner and outer protection are described. The municipal waste water siphon, replacing the old one destroyed by corrosion, has inner cathodic protection by means of foreign current, using a continuous anode near the pipe wall and attached to the latter with opposite electrodes on the pipe wall. Outer protection is accomplished by means of two Fe/Si anodes at a 70 m distance. The inner anode is protected by a plastic tube. The experience gained with the construction of the cathodically protected siphon shows that insulation should follow installation.

*Siphons, *Municipal wastes, *Waste water treatment, Pipes, Plastics, Cathodic protection, Anodes, Installation, Insulation

Germany

D611
CHEMICAL PRECIPITATION OF WASTEWATERS WITH LIME (Kemisk fallning av avloppsvatten med kalk),

Gronkvist, S., Hultman, B., Kapilashrami, S., and Nielsen, P.

Kemisk Tidskrift, Vol. 87, No. 7/8, p 46-48, August, 1975. 3 fig, 1 tab, 19 ref.

Different methods for the precipitation of waste water components with lime are discussed with respect to improved efficiency and reduced lime expenditure. The recirculation of purified water, the precipitation of calcium phosphate compounds on a solid carrier material, such as apatite or sand, and the addition of calcium and fluoride ions are among the basic possibilities to reduce the lime expenditure for precipitation. Very low lime doses of 20 to 24 mg calcium per liter can be used for Biospherics' "Pho-Strip Process", in which precipitation takes place in the return sludge stream. Substantial reduction of the lime dosage may be achieved by a combination of this method and the passage of the entire purified water from the activated sludge process through a filter or apatite bed.

*Waste water treatment, *Chemical precipitation, *Lime, Sludge treatment, Activated sludge, Filtration

Pho-Strip Process

D612
NEW SYSTEM PUTS THE WOOD TO WASTEWATER,

Weber, C. L., and Jacobson, C. D.

Kirkham, Michael and Associates,
Omaha, Nebraska.

Water and Wastes Engineering, Vol. 12, No. 12, p 51-52, 64, December, 1975. 1 fig.

Redwood media roughing filters and a completely mixed activated sludge system are part of the new secondary waste water treatment plant servicing two meat processing industires and the municipal population in Fremont, Nebraska. The joint treatment plant utilizes all the existing facilities of a treatment plant built in 1965. Designed for an average hydraulic load of 10.5 mgd per day, the facilities can treat an organic load of 37,000 pounds per day of BOD and 25,500 pounds per day of suspended solids. In addition, the plant was designed to handle a load of 14,100 pounds of grease per day. A dissolved air flotation system was installed for grease removal prior to primary clarification. To handle the high strength organic waste, the redwood roughing trickling filters were designed to precede the completely mixed activated sludge system. The roughing filters are designed to achieved 50% BOD reduction without recirculation. Other major treatment processes at the plant include pre- and post-chlorination facilities for odor control and disinfection. The construction costs of the secondary treatment plant improvements and modifications were $2.6 million, 80% of which were financed by state and federal grants. After three months of full scale operation, the results are the following: the monthly average flow to the plant is 4.0 mgd with an average strength of 675 mg/liter of BOD; suspended solids in the raw flow are averaging 475 mg/liter while the grease concentration is 260 mg/liter; final effluent discharged from the plant is currently averaging 15 mg/liter of BOD and suspended solids; and grease concentration in the final effluent has averaged less than 10 mg/liter.

*Waste water treatment, *Activated sludge, *Treatment facilities, Food processing industry, Municipal wastes, Nebraska, Costs, Biochemical oxygen demand, Suspended solids

D613
ALIGNMENT OF LONGITUDINALLY AERATING AERATION TANKS
(Naladka aerotankov prodlennoy aeratsii),

Ryazanskiy, G. G., and Lerner, A. D.

Vodosnabzhenie i Sanitarnaya Tekhnika, No. 6, p 32, 1975. 2 fig.

Criticism has been given of longitudinally aerating aeration tanks manufactured currently in the Soviet Union. The inlet grid mesh should be reduced from 10 x 10 mm to at least 5 x 5 mm to prevent large floating pieces from entering the aeration, and hence the return sludge. Also, the aeration intensity should be highest in the inlet section rather than at the outlet section. Aeration tank designs should not be chosen without regard to the climatic conditions under which they are to be operated. In particular, exposed metallic tanks are unsuitable for subarctic and arctic regions.

*Aeration, *Tanks, *Waste water treatment, *Construction materials, Equipment, Climates

Soviet Union

D614
CONVERSION OF A TRICKLING FILTER PLANT TO ACTIVATED SLUDGE,

Fox, D. M.

Clapsaddle-Garber Associates,
Consulting Engineers,
Marshalltown, Iowa.

Public Works, Vol. 107, No. 1, p 48-49, January, 1976.

A deteriorating waste water treatment plant that had been built in 1937 was redesigned and renovated in order to meet EPA effluent quality standards. The existing structure was a typical plant having primary settling, a trickling filter, final settling, a heated anaerobic digester, and sludge drying beds. The plant was subject to flooding from the Iowa River 200 feet away. In order to meet the new standards it was necessary for the plant to produce an effluent BOD of 30 mg/liter, suspended solids of 30 mg/liter, and bacteria colony count of 200 per 100 ml. To renovate the plant, the trickling filter distributor and rock were removed from the 89-foot diameter filter structure and the structure was rebuilt to accommodate the installation of concentric aeration and final settling chambers, the outer annular chamber serving for aeration. The traveling bridge which spans the structure supports two Passavant horizontal axis rotor surface aerators which operate in the outer ring of the basin. The old final clarifier was remodeled to serve as a detention tank for chlorination and the digester was modified to function as an open sludge storage tank and sludge thickener. The waste sludge is thickened and pumped to a tank wagon drawoff or to the sludge drying beds which were rehabilitated. Use of existing structures to the maximum possible extent contributed to the low cost of $302,000 for construction, materials, and site dewatering. The plant produces an effluent suitable for discharge to a river utilized for potable water supply downstream.

*Waste water treatment, *Treatment facilities, *Activated sludge, Construction costs, Water quality standards, Repairing, Aeration

Facilities renovation

D615
REMOVAL OF AMMONIA NITROGEN BY CATALYTIC OXIDATION FILTER BED
(Sesshoku sanka rosho ni yoru ammonia-sei chisso no jokyo),

Iwai, S., Kitao, K., and Tejima, S.

Preprint, Japan Society of Civil Engineers, Tokyo, p 526-527, 1975. 6 fig, 2 tab, 3 ref.

The removal of ammonia nitrogen by activated sludge was studied using a simulation of sewage water containing 50 mg/liter $CaCl_2$, 61 mg/liter $MgSO_4$, 113 mg/liter KH_2PO_4, 252 mg/liter K_2CO_3, and various NH_4Cl concentrations. Activated sludge was placed in a filtration bath. Experiments were performed using both flowing and non-flowing sewage systems, and the ammonium concentrations were measured. The reduction of ammonia nitrogen concentration in the system occurs in two ways: diffusional migration of ammonia nitrogen into the floc, and biological oxidation. The effect of the oxidation rate was examined for the solution pH, dissolved oxygen (DO), organic compounds concentration, and ammonium concentration. The suitable solution pH to give the peak oxidation rate was 7 to 8. The effect of DO concentration was clearly observed even at high DO concentrations, and the oxidation rate increased approximately parabolically with the DO concentration up to 5 mg/liter. The presence of starch in the simulated sewage containing 15 ppm ammonia nitrogen did not have any major effect on the oxidation rate. The removal rates were 0.149, 0.094, and 0.124 mg NH_3-N/liter hr with the presence of starch concentrations of 30, 170, and 200 ppm, respectively. Therefore, the presence of organic compounds could not be considered as a major inhibitory factor for biological nitrification.

*Waste water treatment, *Sewage treatment, *Activated sludge, *Simulation analysis, Oxidation, Biological treatment, Ammonia, Nitrogen, Dissolved oxygen, Organic compounds, Nitrification

Starches

D616
CONVERTING SEWAGE INTO SAVINGS,

Chemical Week, Vol. 118, No. 2, p 47, January 14, 1976.

Producing ammonium sulfate fertilizer will help defray the operating costs of a new tertiary treatment plant being built on Lake Tahoe. The ammonia removal and recovery process produces 40% concentration ammonium sulfate solution from the regeneration stream from the plant's ammonia-stripping ion-exchange beds. The solution contains about 9% available nitrogen, suitable for direct irrigation of sprinkler system application by farmers or for blending by commercial fertilizer manufacturers into ammonium sulfate. The North Lake Tahoe plant will produce between 2.5 and 5 tons of fertilizer per day. The cost of installing the process is about 10% of the total construction cost of the new plant, but the designers say the sale of fertilizer materials will cut operating expenses by 60%. Ammonia is removed from the waste stream by passing over a bed of clinoptilolite. The bed is then flushed with a concentrated sodium chloride solution which "bumps" the ammonia ions into a regeneration solution. With an ammonium concentration of about 300 ppm, the solution is pumped into clarifiers where sodium hydroxide is added to convert the ammonium ions into ammonia gas. In an absorption tower the gas is converted into a 40% solution of ammonium sulfate. The ammonia removal and recovery process is part of a $20 million waste treatment system that includes pure-oxygen-activated sludge treatment, two-stage lime addition for the removal of phosphorus, dual-media filtration, activated carbon adsorption, ion-exchange for ammonia removal, and chlorination for disinfection.

*Tertiary treatment, *Operating costs, *Recycling, Ammonia, Fertilizer, Treatment facilities, Waste water treatment

*Ammonium sulfate fertilizer, Clinoptilolite, Ammonia removal and recovery process (ARPP)

D617
INCINERATION'S ROLE IN ULTIMATE DISPOSAL OF PROCESS WASTES,

Dunn, K. S.

The Incinerator Company,
Huntington, England.

Chemical Engineering, Deskbook issue, p 141-150, October 6, 1975. 5 fig, 4 tab, 16 ref.

With the possibility of reclaiming a product or recovering waste heat, incineration as a final disposal process becomes increasingly interesting. To destroy satisfactorily organic material, the furnace volume must be sized for the physical bulk of material as well as for its calorific value. The correct combustion-air requirements must be met and velocities must be selected to ensure thorough mixing through turbulence in the combustion zone. The high-temperature zones must have a gas path of sufficient length and volumetric capacity to complete the combustion of volatiles. Whether the process of oxidation is to be carried out in grate space or in gas space must be considered. The most flexible incinerator designs for a range of applications are the multichamber/multicell units and the rotaries. Fluid-bed incineration is not very flexible and power consumption is high, but with waste-heat recovery the costs may be offset. The multiple-hearth incinerator has found many successful applications in the metallurgical industry as well as being applied to municipal and industrial wastes, but is is not very flexible either. Flexibility is important because within two or three years from entry into service, wastes will change as the process is modified. As a result, refractory materials must have the flexibility of coping with temperature changes. Monolithics, or refractories taken into service in an unfired state, are replacing brick as the first choice for incinerator work. Among emission collectors, the venturi scrubber is the most popular, but a new two-phase jet system is being studied.

*Incineration, *Waste disposal, *Recycling, Organic compounds, Oxidation, Equipment

Waste heat, Refractories

D618
PROGRESS IN METHODS OF NITRATE REMOVAL,

Goodman, A. H.

Water Treatment and Examination, Vol. 24, No. 3, p 1570-1571, 1975. 12 ref.

Reduction of nitrate content in water can be accomplished using two broad methods. One method, of which ion-exchange and reverse-osmosis are examples, involves concentrating nitrate into a reject fraction. The other method utilizes biological denitrification. Various studies are being conducted on the conditions necessary for denitrification in biological systems. It was known that denitrification occurred in soils and it was observed that in studies of river water nitrate was reduced even though a high level of BOD was present. It appeared that those responsible for denitrification were heterotrophic organisms which utilized not only organic carbon but also nitrogen. It then became apparent that rivers with much oxidized sewage effluent must contain high proportions of nitrate. Therefore, a denitrification step would have to be incorporated into the sewage treatment plant if the rivers were to be a supply of potable water. One system studied was the addition of methanol to sewage effluent, followed by treatment in a flooded biological filter. Then, to overcome the accumulation of solid matter in the filter, experiments were made with upward-flow units containing sand. An unaccountable loss of nitrogen in the aeration plant led to the use of a small amount of air to keep the solids suspended in the water. Eventually it was found that with little additional cost, 50% nitrate removal was possible in existing treatment plants. Work in denitrification continued with an examination of the mechanism whereby ammonia in river water could be oxidized during upward flow settlement. This led to a fluidized sand bed process with methanol introduced to stimulate denitrification. Because the use of toxic methanol in water being made potable would cause concern, the substitution of reducing sugars for methanol is now under consideration.

*Nitrates, *Nutrient removal, *Water treatment, *Waste water treatment, Denitrification, Nitrogen, Methanol, Rivers, Potable water

D619
BIOLOGICAL DENITRIFICATION AND ITS APPLICATION IN TREATMENT OF HIGH-NITRATE WASTE WATER,

Francis, C. W., and Callahan, M. W.

Oak Ridge National Laboratory,
Oak Ridge, Tennessee,
Environmental Sciences Division.

Journal of Environmental Quality, Vol. 4, No. 2, p 153-163, April/June, 1975.
2 fig, 1 tab, 82 ref.

One of the most effective denitrification processes is biological denitrification in which nitrates are converted to nitrogen by microorganisms respiring under anaerobic conditions. The optimum conditions for maximum denitrification include a hydrocarbon for additional cell synthesis, a pH in the range of 7.5 to 8.5, and a temperature range of 45 to 60 C. The modified activated sludge reactor is one basic design that has been developed and tested for denitrification. In this system long residence times are required to prevent loss of microbial mass through washout. Another design, the packed-bed reactor, provides surface area for microbial growth which reduces washout and increases cell concentration. When large flow rates are required, biomass accumulation in the bed increases head loss, and then maintaining a pumping system becomes a problem. Large head losses are an even greater problem in anaerobic columns in which the flow is operated in a downward mode. Although upward flow columns resemble packed-bed reactors, they contain a much lower pore space than the packed-bed reactor. The engineering design used for biological denitrification of nitrate wastes will depend on the dominant complementary and associated cations in the waste. Anaerobic columns appear to be the most effective method for the treatment of nitrate wastes associated with fertilizer and uranium oxide fuel fabrication plants.

*Denitrification, *Biological treatment, *Anaerobic conditions, Activated sludge, Nitrates, Industrial wastes, Fertilizer, Waste water treatment, Cations

D620
QUEBEC'S WATER AND SEWAGE MASTERPLAN FOR MIRABEL REGION,

Water and Pollution Control, Vol. 113, No. 12, p 38, December, 1975. 1 fig.

Because it is predicted that the population around Montreal's Mirabel International Airport will triple within the next 25 years, a masterplan for water distribution and treatment in the area surrounding the airport has been drawn up and released. The plan divides the area into three regions and advises expansion of some existing facilities and construction of some new facilities. Federal and provincial authorities will provide the funding for each municipality, but there is no pressure to comply with the masterplan. The only part presently under construction is the sewage treatment plant for the airport and the adjacent industrial park, but its facilities will not be used by the municipalities. The total projected construction costs for the regional distribution and treatment plants is approximately $114 million.

*Water pollution control, *Waste water treatment, *Sewage treatment, Treatment facilities, Airports, Costs, Administration, Regional development

D621
EDINBURGH'S SEWAGE-TREATMENT AND DISPOSAL SCHEME,

Dugdale, J.

Edinburgh Corporation,
Edinburgh, Scotland.

Water Pollution Control, Vol. 74, No. 6, p 611-624, 1975. 9 fig, 1 ref.

Because of the recent emphasis on improvement of sewage disposal methods, a scheme for improvement of existing facilities was presented to the City of Edinburgh. A number of the aspects of the scheme were investigated and then final approval was given to the scheme in the beginning of 1971. Construction should be completed by the middle of 1976. The existing sewage disposal was done via nine main outfall sewers distributed over 14 km of the city's coastline. The scheme proposed to redirect all the sewage flow to a central point in an interceptor sewer system where primary treatment would be carried out followed by discharge through a sophisticated outfall to the Estuary and disposal of sludge in the sea. The outfall area was studied for current direction and velocity over a wide range of tidal and wind conditions. The raw sludge disposal area in the sea is about 25 km offshore and a tanker for carrying the sludge is under construction. Almost half of the total 15.8 km of interceptor sewer system is already completed. The site of the sewage treatment works was chosen to be the Estuary which required land reclamation. The extent of reclamation was about 22 ha, of which 11.8 ha is for the primary treatment works, and the rest is for future expansion. The sewage treatment works include preliminary treatment, primary treatment, storm-sewage treatment, and sludge storage. The current total estimate of cost of the whole scheme is £22 million, of which almost half is for interception and redirection of sewage. A survey of the biological habitat along a 19 km length of coastline around the city is being conducted before and after operation of the new treatment scheme.

*Sewage disposal, *Waste water treatment, *Construction, *Treatment facilities, *Outfalls, Sewerage, Construction

Scotland

D622
FACTORS IN THE PURIFICATION OF FLOWING SEWAGE AND ACTIVATED SLUDGE PROCESS, PART I,

Pillai, S. C., Srinath, E. G., Viswanathan, C. V., Merra Bai, B., and Kasi Viswanath, G.

Indian Institute of Science,
Bangalore, India,
Department of Biochemistry.

Water and Waste Treatment, Vol. 18, No. 9, p 36, 38, 40, 42, 44, September, 1975. 18 fig, 4 tab.

Because little is known about the purification of sewage in running water, a study was made of the sewage system of Bangalore in which waste water flows through channels to tanks 10 and 25 miles from the city. Samples of sewage were collected from the longest channel which carries daily about 14 million gallons of sewage and has a general gradient of about 1/100. The velocity of the channel water varied from 2 to 8 feet per second. Analysis of the samples of sewage that had traveled about 7 miles in 4 to 6 hours revealed that turbidity values, bacterial count, catalase activity, oxidizable organic matter, BOD, ammoniacal nitrogen, water soluble phosphorus, total phosphorus, and fatty matter had been reduced to the point at which the water could be considered purified. The alkalinity of the same sewage was not comparably reduced and the reason for this is not clear. A test was then conducted to study the influence of turbulence in the running water purification system. Hourly analyses of samples taken for 24 hours did not show any appreciable purification. A test of the growth of protozoa in raw sewage and boiled sewage showed that when protozoan growth was about 20%, purification was appreciable; when protozoan growth was less, purification was negligible. A test comparing the technique of fluidization with the activated sludge process was conducted, producing equal results. The experiments not only establish the role of protozoa in sewage purification, but also indicate the possibility of improving the activated sludge process.

*Activated sludge, *Sewage treatment, *Sewerage, *Protozoa, Alkalinity, Turbidity,

D623
MINIMAL COST PLANT CLEANING UP HARBOR,

Backus, E.

Albertson, Sharp and Backus, Norwalk, Connecticut.

Water and Wastes Engineering, Vol. 13, No. 1, p 16-17, 43, January, 1976.
3 fig, 1 tab.

During the first four months of operation of the Norwalk, Connecticut, new waste water treatment plant, average removals of 90% suspended solids and 86.8% BOD5 were achieved. Secondary treatment begins as the effluent from the primary settling tanks enters the aeration tanks and flows through secondary settling tanks to a chlorine contact tank. Sludge removed from the secondary tanks is returned to the aeration tanks or wasted to a splitter box which can divide the sludge among one to three flotation thickeners. Sludge from the thickeners is concentrated in a Dorr-Oliver tray thickener, and then pumped to a group of four centrifuges. This plant varies from conventional systems in the details of construction rather than in the basic flow pattern. Each of the aeration tanks can be fed in homogeneous, step, or plug flow. The secondary settling tank overflow arrangement is a unique system of fiberglass collecting launders which may be placed anywhere in the last half of the tank where the greatest clarity is observed. An old abandoned, primary digester tank was used to house the new main electrical substation equipment. The plant is located on a 28 acre site much of which used to be flooded at high tide. The plant grade was raised to a level higher than the flood stage of the 1938 hurricane by adding 150,000 cu ft of fill. The fill was obtained from Norwalk's incinerator landfill site which needed more capacity. A stone-faced revetment, with a slope of one on eight, was constructed to retain the landfill.

*Waste water treatment, *Treatment facilities, *Sewage treatment, *Construction, Suspended solids, Biochemical oxygen demand

Norwalk (Conn)

D624
AUTOMATION CAN BE SIMPLE,

Martin, R. J.

Water and Wastes Engineering, Vol. 13, No. 1, p 31, 42, January, 1976. 1 fig, 1 tab.

An automatic system based on the application of simple electro-mechanical controllers has been on stream for over three years in two waste water treatment plants in Sheburne and Alfred, New York. The system comprises an electro-mechanical controller that energizes circuits which provide automatic control for the routine operations of drawing supernatant and pumping sludge and scum. The stepping drum controller initiates a sequence of opening and closing valves, and starting and stopping pumps, heater, mixer and sludge collectors. Each step is actuated by a signal indicating that the preceding step is finished. A malfunction in any step will return all the units to the "at rest" mode and actuate alarm lights and/or audible alarms. The drum will remain at the step on which the malfunction occurred, permitting the operator to easily determine the type of malfunction. The controller includes: a perforated aluminum drum, step-driven by an electric motor; a series of roller-lever-actuated snap-action switches; terminal strips for input and output connections; and, control circuitry for the drive motor. Points around the circumference of the drum correspond to the steps of the treatment program while points along the axis of the drum correspong to individual control outputs. The system was installed in each plant for about $25,000.

*Waste water treatment, *Treatment facilities, *Automatic control, *Automation, Control systems, Instrumentation, Equipment, Sewage treatment, Costs

D625
THIS PLANT CAN USE 5 SLUDGE PROCESSES,

Vonic, M.

Rist-Frost, Associates,
Glens Falls, New York,
Department of Environmental Engineering.

Water and Wastes Engineering, Vol. 13, No. 1, p 26-28, January, 1976. 4 fig, 1 tab.

The new 2 mgd waste water treatment plant designed for the Village of Saranac Lake, New York, is capable of maintaining between 90% and 96% BOD and suspended solids removal despite substantial fluctuations in waste water flow due to a large summer tourist population. The plant can be operated with five different types of activated sludge processes which permits the operator to produce a high quality of effluent even though the flow and temperature vary considerably. During 1974, the plant operator was able to achieve a consistently high plant performance with an average of 92% BOD and suspended solids reduction, using only half of the available biological reactor capacity. The main sludge process utilized during this period was "two stage"-"step feed". The food to microorganism ratio (F/M) was maintained between 0.2 and 0.4; the sludge age varied between four and eight days; average age was five days. A mixture of raw and waste activated sludge is thickened in a gravity sludge thickener and then pumped to the primary heated digester. The use of a thickener has reduced the cost of heating the sludge for digestion. The total cost of the facilities was about $2 million.

*Waste water treatment, *Activated sludge, *Control systems, *Treatment facilities, Flow, Temperature, Costs

D626
AERATED LAGOONS SOLVE TOWN'S SITE PROBLEMS,

Goodnow, W. E.

Burns and McDonnell Engineering,
Kansas City, Missouri.

Water and Wastes Engineering, Vol. 13, No. 1, p 40, January, 1976. 1 fig.

Lee's Summit, Missouri, has installed two aerated lagoons at its Vale Treatment Facility. They have a combined volume of 92.8 million gal. The lagoon bottoms and dikes were constructed of compacted earth and no liners or sealer were required. The aeration system is 7,300 feet of plastic header pipe carrying air supplied by three 30-hp Roots positive displacement blowers operating simultaneously to deliver 595 cfm each of six to seven pounds pressure. Air-Aqua aeration tubing (84,500 feet) creates a pattern of 168 aeration cells. Openings in the tubing release a constant stream of small air bubbles which form linear screens dividing the lagoons into separate treatment cells, mixing the liquid contents, and efficiently transferring oxygen. Effluent dissolved oxygen measurements are consistently greater than 4 ppm. Three cleanings/year are required for the aeration system to remove the carbonate deposit buildups around the aeration tubing outlets. Anhydrous HCl gas is used for cleaning. The gas hydrolyzes into an acid upon contact with water and dissolves the deposits of calcium and magnesium carbonates.

*Waste water treatment, *Sewage treatment, *Aerated lagoons, Aeration, Equipment, Cleaning, Pipes, Oxygenation, Lagoons

Oxygen transfer

D627
BIOLOGICAL NITRIFICATION OF SLUDGE SUPERNATANT BY ROTATING DISKS,

Lue-Hing, C., Obayashi, A. W., Zenz, D. R., Washington, B., and Sawyer, B. M.

Metropolitan Sanitary District of Greater Chicago, Chicago, Illinois, Research and Development.

Journal Water Pollution Control Federation, Vol. 48, No. 1, p 25-46, January, 1976. 11 fig, 10 tab, 9 ref.

In its search to find a practical method of reducing the ammonia nitrogen content of its sludge lagoon supernatant (SLS), the Metropolitan Sanitary District of Greater Chicago (MSDGC), Illinois, evaluated the nitrification of SLS by the rotating disk system (RDS). The SLS taken from the digested sludge holding basins at the District's land reclamation site in Fulton County was tested in a rotating disk pilot unit consisting of a 35 gal semicircular tank which was divided into four equal compartments and contained polyethylene disks providing 250 sq ft of total surface area. During the 47 weeks of the experiment, successful nitrification of a high-strength ammonia waste water was achieved under both ambient summer and winter conditions. At an overall ammonia nitrogen loading of 15.5 lb NH3-N/day/1000 cu ft and a waste water temperature of 10 C, 99.4% of the ammonia was removed. Increasing the loading to 43.5 lb and the temperature to 20 C increased the ammonia removal to 99.8%. Significantly higher removal rates would be possible if uniform growth could be established over all of the disks of the four stages. Nitrifying growth must be established on the disks before the beginning of winter. The effects of clarifying the effluent and recycling the flow during winter operation in an attempt to improve nitrification efficiency were minimal.

*Waste water treatment, *Nitrification, *Biological treatment, Ammonia, Nitrogen

*Rotating disc system

D628
REMOVAL OF DETERGENT FLUORESCENT WHITENING AGENTS FROM WASTE WATER,

Ganz, C. R., Liebert, C., Schulze, J., and Stensby, P. S.

Journal Water Pollution Control Federation, Vol. 47, No. 12, p 2834-2849, December, 1975.

Although studies have shown that fluorescent whitening agents (FWA) in detergents are innocuous, little is known about their removal from water and ultimate disposal. In-depth analyses of representative waste water treatment plants' abilities to remove FWA's were made by analysis of solid and liquid influent and effluent. On the whole, the removal of FWA's in the primary process correlated with the removal of suspended solids. The trickling filter process eliminated much of the remaining FWA's so that average FWA removal was on the order of 95%. FWA content in the settled sludge was in the milligram per liter range. Because these results showed that much of the FWA's discharged into the treatment plants was removed as part of the solid waste component, it was deemed appropriate to determine whether FWA's in sludge landfill could be leached out by rainwater. Core samples from simulated landfill sludge exposed to natural conditions showed that a negligible quantity of FWA's was leached from the sludge over a 70-day exposure period. Since there is some interest in using sludge for a soil improvement agent, the ability of crops to accumulate FWA's from treated soil was studied. It was suggested that FWA's will not likely be taken up by major crops when present in planting soils.

*Detergents, *Waste water treatment, Suspended solids, Trickling filters, Solid wastes, Toxicity, Soils, Waste disposal

Fluorescent whitening agents (FWA)

D629
SLUDGE DEWATERING TRIALS AT BANBURY,

Sidwick, J. M., Butler, B. E., and Ruscombe-King, N. J.

Water Pollution Control, Vol. 74, No. 6, p 675-687, 1975. 4 fig, 3 tab, 3 ref.

Five centrifuge machines were tested and compared for efficiency in dewatering crude sludge. Of the machines tested, four were long-bowl decanters and one was an internal-bowl machine. During the trial week 23 runs were completed by the machines. The operators were asked to produce a sludge cake containing 22 to 23% dry solids with a centrate containing 750 to 1000 mg/liter. No other constraints were imposed. The same feed sludge was fed to all machines. The results show that all the centrifuges had difficulty in achieving centrate suspended solids concentrations below 1000 mg/liter, but both methods were suitable for dewatering sludge. The long-bowl machines were more successful in producing a cake of the required quality than the internal-bowl machine. After the trial week, one machine was kept for further testing to see whether its results could be improved with different throughput rates and different polyelectrolyte dosages. Recovery improved for that machine as throughput was reduced. For any one throughput, there is an optimum polyelectrolyte dose. At higher throughputs, recovery is more sensitive to changes in polyelectrolyte dose. More detailed analysis of operating variables was not possible during the short time of this trial.

*Sludge treatment, *Dewatering, *Centrifugation, *Equipment, Polyelectrolytes, Operation, Design criteria, Suspended solids

Centrifuge machines

D630
ANAEROBIC DIGESTION OF SLUDGE,

Weland, A. F., and Cheremisinoff, P. N.

Malcom Pirnie Incorporated,
Paramus, New Jersey.

Water and Sewage Works, Vol. 122, No. 11, p 45-47, November, 1975. 3 fig, 1 tab, 30 ref.

The design parameters of anaerobic digestion are reviewed, with emphasis placed on specific advantages and disadvantages of the process. The physical parameters of anaerobic digestion are detention time, temperature, influent solids concentration, mixing, and solids loading. Temperature and detention time are interrelated. If bacterial growth is stimulated by temperature, the stabilization rate increases. Solids retention time is generally 10 to 15 days. Solids retention time (SRT), solids loading, and volatile solids concentration are also interrelated. If solids loading is 0.10 lb VSS/cu ft/day and SRT is 10 days, then a minimum of 1.5% volatile solids is required. The chemical parameters of anaerobic digestion are pH, alkalinity, volatile acid, nutrients, and toxic materials. Alkalinity and pH are interrelated. Ideal environmental conditions are pH values of 6.6 to 7.4. The ratio of volatile acids to total alkalinity should be approximately 0.5. Sludges from sewage treatment plants and meat packing houses contain all the necessary nutrients, but wastes containing carbohydrates of fats require additional nutrient or seed materials. Industrial wastes are usually the cause of toxicity. This may be eliminated or reduced by dilution, precipitation, use of antagonist ions, process by-pass, or process modification. An equation was developed for the kinetics of digestion. The development of high rate systems has improved the overall efficiency of anaerobic digestion, but recent advances in incineration processes indicate a trend toward the replacement of the digestion process.

*Design criteria, *Anaerobic digestion, *Biological treatment, Waste water treatment, Alkalinity, Toxicity, Equations, Kinetics

D631
ACTIVATED BIO-FILTER PROCESS,

Owen, W. F., and Slechta, A. F.

Water and Sewage Works, Vol. 122, No. 11, p 60, November, 1975.

The two-stage activated bio-filter process, employing both fixed film and activated sludge biologic reactors, is a new development in secondary treatment. The ABF is unique in that fixed and suspended growth microorganisms are utilized in the first-stage reactor, called the "bio-cell". The process includes a bio-cell lift station, a fixed film reactor, flow control and splitting, a short detention aeration basin, a clarifier, and return sludge facilities. In a trial run at Corvallis, Oregon, the ABF system, with an influent NH3-N concentration of 45 mg/liter and a bio-cell loading of 350 lbs BOD day/1,000 cut ft, removed over 90% BOD and ammonia. The ABF can be applied for any biological waste treatment system. Low power and land use requirements make it suitable for municipal treatment plants. Standard techniques are used in design, construction, and operation of the ABF system. It has been shown to be cost-effective because the efficiency of the first-stage treatment necessitates only a small second-stage aeration basin.

*Biological treatment, *Filters, *Filtration, Microorganisms, Ammonia, Biochemical oxygen demand, Waste water treatment, Activated sludge

Cost-effectiveness, Bio-filters

D632
UPGRADING PRIMARY TREATMENT WITH CHEMICALS AND WATER TREATMENT SLUDGE,

Wilson, T. E., Bizzarri, R. E., Burke, T., Langdon, P. E., and Courson, C. M.

Greeley and Hansen,
Chicago, Illinois.

Journal Water Pollution Control Federation, Vol. 47, No. 12, p 2820-2833, December, 1975. 12 fig, 7 tab.

In order to upgrade the quality of effluent water in Tampa, Florida, a study was undertaken to develop a chemical treatment program and a sludge handling program. A preliminary laboratory screening of processes indicated that a combination of alum and high-molecular weight anionic polymer would be a promising coagulant. Other preliminary studies indicated that suspended solids (SS) removal could be correlated with phosphorus removal and that there was a relationship between alum dosage and effluent SS concentration. During the main study alum and polymer were added to the influent on a 24-hr/day basis and the alum was paced according to the orthophosphorus concentration. This concentration was about 2 mg/liter, corresponding to an estimated effluent SS concentration of about 30 mg/liter. The effluent SS remained below 30 mg/liter when the effluent orthophosphorus was below about 1.6 mg/liter. When chemicals were added the percentage removal and effluent concentrations of BOD and SS were superior to those when no chemicals were added. Because laboratory tests indicated that addition of water works sludge should improve performance and SS removal, it was attempted. Each time sludge was discharged to the system, performance suffered. It was then hypothesized that the sludge was being taken at too high a rate, and, upon regulation, the sludge was accepted. At times of high waste water flow or low water works sludge discharge, alum was necessary to maintain high removal efficiencies. The resulting raw sludge was slightly lower in solids content but no other significant changes from previous operation were noted.

*Waste water treatment, *Suspended solids, *Biochemical oxygen demand, Coagulation, Nutrient removal, Polymers

D633
USING WASTEWATER SOLIDS TO RECLAIM STRIP-MINED LAND,

McMillan, H., and Carlson, R.

Metropolitan Sanitary District of Greater Chicago,
Chicago, Illinois.

Transactions of the Society of Mining Engineers, Vol. 258, No. 4, p 273-278, December, 1975. 4 fig, 5 tab, 5 ref.

To cope with 700 dry tons of waste water solids produced each day, the Sanitary District of Chicago chose land application, and conducted tests before initiating a strip-mined land reclamation program. One demonstration project undertaken by the Sanitary District showed that annual yields of corn were consistently higher with sludge application than without it. Another demonstration involved reclamation of acid strip-mined land. Applications of liquid sludge supported cover crops while the control with no sludge did not. Samples of drainage water from the mine showed that the vegetation growth retarded the rate of acid production. The pH of the surface soil after liquid application was high enough to keep the metals from going into solution. A sophisticated research project was conducted at the University of Illinois. Drainage water from plots of various soils treated with liquid waste was analyzed. After passage through a natural sand filter, drainage water consistently contained less than the standard limit for nitrate. Addition field experiments with corn and soybeans showed that the liquid fertilizer was an effective source of nitrogen and phosphorus for crops. Encouraged by the results of the University tests and its own demonstration program, the Sanitary District purchased 10,000 acres of land that had been strip-mined for coal. The Sanitary District plans to apply 75 dry tons of sludge per acre the first year, 60 tons the second year, 45 tons the third year, and 30 tons the fourth year, at which point the program will be reevaluated.

*Land reclamation, *Waste water treatment, *Strip mines, Waste disposal, Sludge disposal, Acid mine water, Liquid wastes, Crops

Land application, Chicago (Ill)

D634
AN ECONOMIC STUDY OF THE UNOX AND CONVENTIONAL AERATION SYSTEMS,

Sidwick, J. M., Lewandowski, T. P., and Allum, K. H.

Water Pollution Control, Vol. 74, No. 6, p 645-656, 1975. 5 fig, 3 tab, 3 ref.

The cost of the Unox treatment system was compared with conventional aeration systems. The Unox system differs from the activated sludge process primarily in that oxygen-enriched air is the source of oxygen for the microorganisms in the aeration tank. Although the process has been known for a long time, it was thought to be impractical cost-wise. A system using a staged reactor and a covered tank in such a manner as to achieved 90% utilization of the generated oxygen gas was linked up with an oxygen-production unit employing molecular sieves. The new system, the basis of the Unox system, allowed comparatively low cost production of oxygen in small tonnage requirements. Process parameters of the Unox system and the conventional activated-sludge system are given and the capital and operating costs are then compared. The total capital costs of the Unox plant were lower throughout the range of flows and treatment systems considered, but the operating costs were higher for the Unox system. The lowest plant capital costs resulted from treating unsettled sewage. The higher operating costs when operating on unsettled sewage offset any gains in reduced capital expenditure on these plants. Circular Unox treatment units were cheaper than rectangular for most of the systems considered. The Unox system offered a treatment process which was directly competitive with conventional aeration processes throughout the plant range studied. The process would be best operated on settled sewages in the United Kingdom to avoid any problems with sludge disposal.

*Aeration, *Activated sludge, *Oxygenation, Operating costs, Capital costs, Biological treatment, Sewage treatment

UNOX system

D635
NOVEL AERATION SYSTEM BOWS,

Hines, D. A., Bailey, M., Ousby, J. C., and Roesler, F. C.

Imperial Chemical Industries, Limited,
Billingham, Cleveland, England,
Agricultural Division.

Water and Wastes Engineering, Vol. 12, No. 12, p 59-64, December, 1975.

A new aeration process for effluent treatment has been developed as a spin-off from basic aerobic fermentation technology for single cell protein development. Using a deep shaft, the process operates as a modified air-lift fermenter with air injection and may be used for municipal or industrial waste of any strength. It differs from the single cell protein production technology in that the air-lift type of fermenter not only provides biological oxidation but also provides the driving force for liquid circulation. A deep shaft, partitioned into two sections, forms the basis of the process design. Liquid effluent enters the apparatus continuously and is circulated by air pressure many times around the shaft during its time in the system. It then overflows by gravity for solids separation. To establish the effect of pressure oscillations on microorganisms in the activated sludge, a simple experiment was carried out. Nitrogen sparged at varying pressures through a vessel half-filled with activated sludge produced no decrease in viability or respiratory activity of the sludge. Electron micrograms and investigation by light-microscopy showed no evidence of cell rupture. Results from the deep shaft pilot plant have confirmed the validity of these initial experiments. The advantages of the deep vertical shaft are the minimal land requirement, the elimination of primary settlement, less sludge for disposal, the easily-supplied oxygen requirement, and the possible combination of activated sludge and aerobic digestion duties in a single shaft.

*Aeration, *Waste water treatment, *Biological treatment, Separation techniques, Microorganisms, Activated sludge, Pilot plants

Deep shaft

D636
MOVING BED FILTER PERFORMANCE STUDIES,

Mixon, F. O.

Research Triangle Institute,
Research Triangle Park, North Carolina.

Chemical Engineering Progress, Vol. 71, No. 12, p 40-46, December, 1975. 6 fig, 2 tab, 5 ref.

The advantages of a new moving bed filter in treating both raw sewage and secondary effluents is that the filter medium is continually removed, cleaned, and recycled to the filtration zone. This moving bed contactor process should compete with and perhaps replace clarification, fixed bed filtration, microscreening and moving bed filters of countercurrent or crosscurrent design. The advantages of the moving bed contactor are that the equipment is simple, the filter can handle high and low suspended solids concentrations, the continuous operation feature simplifies materials handling and process automation, there is an inherent headloss stability, and its mechanism is analogous to graded filter media. In this moving bed process, the filter medium is slurried with incoming process feed and fed to the bottom of the moving bed contactor. Once inside, the filter medium rises because of buoyancy and viscous drag to the bottom of the performed porous plug of filter medium where it is deposited and thus replenishes the porous plug. Water is forced through the plug and is discharged by gravity at the lateral retaining screens, simultaneously undergoing filtration and forcing the plug slowly upward. At the top of the column, the emerging porous plug is harvested by a mechanical scraper and discharges filter medium into an auxiliary tank from which it is washed and returned to the process. After a year's testing, data showed that from 62 to 82% of the suspended solids in raw sewage was removed by the moving bed unit at flow rates ranging from around 3.5 to 7.5 gal/min/sq ft.

*Filters, *Filtration, *Sewage treatment, *Waste water treatment, Equipment, Suspended solids, Recycling, Cleaning, Flow rates

D637
CAERNARFON SLUDGE GOES UP IN SMOKE,

Bailey, M. C., and Palmer, J. G.

Surveyor, Vol. 146, No. 4355, p 18-21, November, 1975. 2 fig.

A fluidized bed reactor was chosen for the new incineration plant being installed in the tourist town of Caernarfon, United Kingdom. Incineration was chosen over other sludge disposal methods because it takes place at the treatment plant site and it is odorless. Disposal of sludge as fertilizer was not suited to the grazing land around the town, and drying the sludge in open beds is not practical due to the average 60 inches of rainfall each year. The Caernarfon sludge will not be dry enough to be autothermic, so supplementary fuel oil will be necessary. To remove the sulfur from the gas emissions produced not only by the sludge waste but also by the fuel oil, a dry gas cleansing system with limestone or dolomite will be annexed to the incinerator. Particulate matter and heat will be recovered in a heat exchanger. Since the incinerator requires preliminary dewatering of the sludge, centrifuging was selected as the most economical and the simplest dewatering method. A feature of the centrifuge is the 100% standby capacity that insures that the incinerator will never be out of action if the dewatering plant fails. The total sewage treatment works were designed to cope with flows from a population of 12,500 but can be expanded to handle flows from a population twice that size. The treatment plant construction is completed and the incinerator is scheduled to be completed by March, 1976.

*Incineration, *Sludge treatment, *Dewatering, *Sludge disposal, Centrifugation, Odor, Sulfur, Sewage treatment, Treatment facilities, Design

Fluidized bed reactor

D638
SLUDGE DISPOSAL ALTERNATIVES,

Kalinski, A. A., Pincince, A. B., Klegerman, M. H., and Flynn, T. F. X.

Water and Sewage Works, Vol. 122, No. 11, p 61, November, 1975.

Incineration or pyrolysis was found to be the most cost-effective, technically feasible, and environmentally acceptable method for disposing sludge, according to the results of a study funded by the EPA for the New York-New Jersey area. The study took into consideration that the present sludge production of 600 tons/day may expand to 2000 tons/day by the year 2000. It was assumed, based on present values, that the volatile solid content would be about 50% of the total, and the fuel value of the total solids would be approximately 5,000 Btu/lb. An average value of 4% solids was assumed. The choice of incineration as the best method was made in comparison with disposal of either liquid digested sludge or dewatered sludge cake on a strip mine area 100 miles from the study area. In this comparison, the total cost of disposal was over double the net cost for incineration or pyrolysis. The possibility of producing a commercial fertilizer from the sludge was not even comparable to incineration due to the high expense of ferlizer production. The incineration process includes sludge conditioning with chemicals and use of filter pressing to obtain a 40% solids sludge cake. During normal operation, the system for incineration or pyrolysis will consume no auxiliary fuel, except if afterburning is required, and the energy recovery will supply all electrical requirements of the sludge processing facility. Moreover, there will be a significant amount available for other uses.

*Incineration, *Burning, *Sludge disposal, *Costs, Fertilizer, Energy, Sludge treatment

*Pyrolysis

D639
THERMOPHILIC MICROBIOLOGICAL TREATMENT OF HIGH STRENGTH WASTEWATERS WITH SIMULTANEOUS RECOVERY OF SINGLE CELL PROTEIN,

Surucu, G. A., Engelbrecht, R. S., and Chian, E. S. K.

Illinois University,
Urbana,
Department of Civil Engineering,

Biotechnology and Bioengineering, Vol. 17, No. 11, p 1639-1662, November, 1975.
10 fig, 3 tab, 38 ref.

To determine the kinetic and operating parameters of a thermophilic system of waste water treatment, the kinetic coefficients of an aerobic thermophilic mixed culture system were calculated, the effects of solids retention time (SRT) on the biomass was demonstrated, and the economics of protein recovery were assessed. A mixed culture of thermophilic organisms from soil, streams, waste water, and silage was prepared and studied for various growth characteristics at 58 C in a medium containing glucose, the carbon source, and other nutrients. The biomass was then measured for cell mass, COD, and protein content. A series of experiments were performed at eight different SRT values. The resulting data were than applied to the Monod kinetic model. The kinetic parameters of saturation constant, substrate utilization rate, and death rate for a thermophilic system were much higher than those of a mesophilic system, while the yield coefficient was somewhat lower. Over 90% removal of soluble COD was observed with a SRT of two days and it improved with increasing SRT. The protein content of the biomass increased as the dilution rate decreased. However, because of a significant increase in the apparent cell yield with higher dilution rates, the net protein yield was found to increase with increasing dilution rates. A decrease in oxygen consumption per unit quantity of protein produced with increasing dilution rates also favored the economics of protein production.

*Waste water treatment, *Kinetics, *Aerobic conditions, *Thermophilic bacteria, Biological treatment, Model studies, Chemical oxygen demand, Proteins

Solids retention time, Biomass

E001
ASBESTOS IN DRINKING WATER,

Kay, C. H.

Ministry of the Environ, Toronto, Ontario, Pollution Control Branch, Contingency Planning Section

Journal of the American Water Works Association, Vol. 66, No. 9, p 513-514, September, 1974. 4 tab.

A study of the water supplies of 22 cities in Ontario, Canada, was performed to assess the water samples for asbestiform fibers. Charts are included which present the asbestos fiber count and estimated mass concentration by distribution system water and the asbestos fiber count analysis. Asbestos is apparently present in all surface waters of inhabited areas of Ontario. After evaluations of known information, the Ontario Ministry of Health advised that at the levels of concentration and size distribution of fibers reported, there was no evidence of an effect on health by the ingestion of asbestos particles. The City of Duluth, Minnesota, also discovered asbestiform fibers in its drinking water. Duluth will probably have to provide treatment, such as complete treatment filtration, of its drinking water. Research needs to continue on the health hazard that may or may not be present at various levels of asbestiform fibers in drinking water supplies.

*Public health, *Asbestos, *Analytical techniques, *Potable water, Water sources, Water supply, Pollutant identification, Water pollution sources, Foreign research, Filtration, Minnesota, Canada

*Asbestiform fibers, Ontario (Can), Duluth, (Minn)

E002
WATER MONITORING IS BIG BUSINESS,

Water and Pollution Control, Vol. 112, No. 9, p 14, September, 1974.

Monitoring Canada's lakes and rivers is a multi-million dollar proposition. A national network of over 600 fixed sampling stations are operated to assess the state-of-health of lakes and rivers and to show trends in water quality. Samples taken which are considered representative of the entire water system are analyzed for about 90 parameters which are then used to evaluate water quality. Specific tests are conducted to describe important basic conditions such as dissolved oxygen content and pH, indicative of the general health of a particular body of water. Identification and monitoring of trace metals is performed to guard against toxic conditions and effects. Equipment such as the AutoAnalyzer and the atomic absorption spectrophotometer have greatly reduced the time required for an analysis of trace metals. The Canada Centre for Inland Water laboratory is responsible for operating a quality control program to ensure reliability of data and for developing new analytical procedures and techniques. The data from the past ten years of sampling are being interpreted for water quality reports for each province. After the report is finished for a province, biannual water quality reports will then be published to inform the public of improvements or setbacks in the aquatic environment.

*Monitoring, *Water analysis, *Water quality control, *Analytical techniques, Canada, Pollutant identification, Chemical analysis, Sampling, Water sampling

Canada Centre for Inland Water

E003
THE INFRARED STUDIES OF SANTA BARBARA CHANNEL OIL SPILL,

Tu-Ching, T.

Cincinnati University,
Cincinnati, Ohio

Dissertation Abstracts International B, Vol. 35, No. 6, p 2601, December, 1974.

A twelve-month study was carried out to evaluate the effects of a spill from an oil well in Santa Barbara Channel, in southern California, which occurred January 28, 1969. The study evaluated infrared analytical techniques for qualitative identification of different oils and establishment of background levels of hydrocarbon control of marine sediments; studied the movement and deposition of oil both from the spill and from natural seeps in the Santa Barbara Channel; investigated the effect of the size and nature of the sediment on the movement of oil; and correlated the oil movement with sediment formation and movement and natural current patterns. Internal reflection spectroscopy (IRS) was used to analyze 374 samples which had previously been studied by the IR transmission technique. Different mineral composition of sediments was found to complicate the quantitive determination of oil. Conflicting results were discovered in some cases on the composition of sediments by x-ray diffraction methods and by IRS spectra methods; theoretical analysis showed that phosphate was the major constituent of the sediments. In addition, the study of the surface active agent, considered as a pollutant, and its effect on the crystal nature of hydroxyapatite precipitates was presented.

*Oil spills, *Oil wells, California, Pollutant identification, Infrared radiation (IR), Analytical techniques, Organic compounds, Water pollution effects

Internal reflection spectroscopy (IRS), Santa Barbara Channel (Calif)

E004
A REMOTE SENSING LASER FLUOROMETER,

O'Neil, R. A., Davis, A. R., Gross, H. G., and Kruus, J.

Environment Canada,
Water Science Subdivision/Inland Waters Directorate,
Ottawa, Canada

Laser and Unconventional Optics Journal, No. 52, p. 3-44, May, 1974. 26 fig, 7 ref.

A remote sensing laser fluorometer has been constructed to observe organic and biological materials in water. By remote sensing, larger areas may be observed than by point sampling techniques. The use of an airborne fluorosensor, as developed by the Department of the Environment (Canada), was to be solely for detecting oil spills. Its uses now have been applied to chlorophyll and to dye and other industrial chemical wastes. Although the fluorometric device cannot make unambiguous identification of oil types, the instrumentation has wide application in monitoring naturally occurring waters for pollutants. When used in combination with stream gauging stations or controlling automatic sampling units, a remote sensing laser fluorometer could provide useful data on the temporal rather than the spatial characteristics of the water flowing past the sensor. Further uses include making remote reflectance measurements, although it would be limited to a single wavelength.

*Remote sensing, *Fluorometry, Analytical techniques, Sampling, Oil Spills, Pollutant identification, Instrumentation streams, Chemical wastes, Monitoring

*Lasers

E005
ORGANIC CONTAMINANTS IN RAW AND FINISHED WATER,

Cameron, C. D., Hoehn, R. C., and Strimaitis, J. R.

Fairfax County Water Authority, Annadale, Virginia

Journal of the American Water Works Association, Vol. 66, No. 9, p 519-523, September, 1974. 3 fig, 5 tab, 21 ref.

Water authority personnel in Fairfax County, Va., have initiated a program to monitor the malodorous contaminants in finished and raw water in an attempt to eliminate them. The cause of tastes and odors in water is generally the organics transported by and generated in the water system. The word organics, on a practical basis for the water industry, is synonymous with trade wastes, such as naphthalene, styrene, ethylbenzene, agricultural products such as dieldrin, aldrin, and DDT, and also natural materials such as humic and fulvic acids. Three methods are being used for the monitoring: the high-flow carbon-adsorption method; the low-flow carbon-adsorption method; and, the new Organics-Carbon Adsorbable mini (O-CAm). The results of the three methods are illustrated by graphs. The Mini method is an improved technique over the first two. All of the methods rely on the adsorption of organics upon a fixed bed of granular carbon through which is passed the sample water. A bank of CCE and CAE residues have been accumulated by the Fairfax County Water Authority from both raw and product waters. These and future residues will be used to demonstrate which types of treatment methods are capable of producing the greatest reduction in organics. These organic residues are also being used for additional analysis through gas chromatography and advanced techniques for organochlorine hydrocarbon pesticides.

*Monitoring, *Organic compounds, *Taste, *Odor, Potable water, Organic pesticides, Organic acids, Organic waste, Hydrocarbon pesticides

E006
DEVELOPMENT PROGRESS WITH SALWICO POLLUTION MONITORING SYSTEM,

Marine Week, Vol. 2, No. 5, p 26, January 31, 1975.

An oil pollution monitor has been developed by a Swedish company in order to monitor all normal black and white oils without need for individual setting or calibration. This Salwico monitor, from Salen and Wicander AB, concentrates the oil before scanning it for discoloration and gas evaporation. A rated flow of sample water is fed through a filter band and moved at a constant velocity. The oil density per area unit of the band is thus a direct function of the oil content in the water. Discoloration of the filter band is measured by a photo cell directly after exposure to the sample water; two signals given are added together, giving a minimum spread between different oils. The equipment is built into one analyzer unit and one control indicator panel. The latter is mounted in a cargo control room while the analyzer contains the wet compartment with pumps and piping, and is either mounted in a small deck cabinet or in the pump casing bulkhead. As pollution control equipment, the monitoring system has now been tested and put into series production.

*Oil wastes, *Oil spills, *Water pollution control, *Monitoring, Analytical techniques, Pumps, Equipment

Oil density measurement

E007
PETROLEUM POLLUTANTS IN SURFACE AND GROUNDWATER AS INDICATED BY THE CARBON-14 ACTIVITY OF DISSOLVED ORGANIC CARBON,

Spiker, E. C., and Rubin, M.

U. S. Geological Survey,
National Center-971,
Reston, Virginia

Science, Vol. 187, p 61-64, January 10, 1975. 1 tab, 23 ref.

Dissolved organic carbon (DOC) consists of organic compounds such as humic and fulvic acids, herbicides, pesticides, synthetic detergents, phenols, and petroleum hydrocarbons. Once the organic matter decomposes, carbon compounds are altered. While carbon dioxide is recycled, the carbon-14 content of organic carbon is not significantly affected by the synthesis. For this reason, the 14C activity of dissolved organic carbon can be used to distinguish between the two classes of organic carbon--those from petrochemical effluents and those from municipal wastes and agricultural runoff. The industrial wastes are composed of fossil petroleum products which contain no 14C; the modern domestic wastes and naturally decaying matter contain approximately the modern atmospheric carbon-14 content. Rivers polluted by petrochemical effluents showed varying amounts of depression of the DOC 14-C activity, which reflects concentrations of 14C-deficient fossil carbon of as much as 40 percent of the total DOC. Studies of six rivers in the eastern United States were consistent with a model; seasonal variations in runoff and stream discharge were considered.

*Oil pollution, *Carbon radioisotopes, *Municipal wastes, Industrial wastes, Organic compounds, Pollutant identification, Rivers, Groundwater, Surface water

*Petroleum effluents, C-14, Dissolved organic carbon

E008
IDENTIFICATION OF CRUDE OIL LEAKS AT SEA
(IDENTIFICAZIONE DELLA FONTE DI SPANDIMENTI DI PETROLIO GREZZO IN MARE),

Hardi, A. M.

La Rivista dei Combustibili, Vol. 28, No. 10, p 367-371, October, 1974.
4 fig, 3 tab, 4 ref.

By ascertaining oil quality, the origin of accidental oil spills may be identified. The composition of crude oil is best analyzed when commonly carried oils are available for comparison. An example of steps taken to identify two crude oil spills in territorial waters is detailed. Gas chromatography of selected distillate fractions from the oil recovered was used. The keys used for identification were quantitative determination of vanadium and nickel from distillation residues.

*Oil spills, Analytical techniques, Waste disposal, Pollutant identification, Nickel, Oil pollution

Vanadium, Italy

E009
SOLVENTS IN SEWAGE AND INDUSTRIAL WASTE WATERS: IDENTIFICATION AND DETERMINATION,

Ellison, W. K., and Wallbank, T. E.

Water Pollution Control, Vol. 73, No. 6, p 656-672, 1974. 14 fig, 1 tab, 4 ref.

Infra-red and ultra-violet spectroscopy in conjuction with gas chromatography is discussed as a powerful technique for detecting and identifying traces of immiscible solvent residues in samples of industrial waste waters, sewages, and sludges. Such solvent residues are important in that the presence of chlorinated hydrocarbons in very small amounts may adversely affect the digestion of sewage sludge. The presence of petroleum products often masks the presence of traces of aromatic hydrocarbons and other solvents containing carbon-oxygen and carbon-chlorine bonds by gas chromatography. These can be readily detected in such cases by infra-red and ultra-violet spectroscopy. Equipment used for analysis and recovery of traces of solvents is described.

*Sewage, *Industrial wastes, *Analytical techniques, Sludge, Gas chromatography, Spectroscopy, Sewage sludges, Pollutant identification

*Hydrocarbon identification

E010
A NEW INFRARED INSTRUMENT FOR MONITORING OIL FILMS ON WATER,

Wright, D. E., and Wright, J. A.

Marine Technology Society Journal, Vol. 9, No. 1, p 22-24, January, 1975. 4 fig.

A new infrared oil film monitor has been developed to detect oil slicks by remote methods. The technique is based on the infrared reflectance properties of water surfaces at the three-micron spectral region where sharp changes in reflectance occur due to absorption bands. The reflectance of water differs from the reflectance of an oil film with regard to a peak and valley shaped graph for water spectral reflectance, absent with an oil film. Both laboratory and field tests have shown that this instrument can detect oil spills during all weather and lighting conditions. Design changes have improved the Infrared Oil Film Monitor to operate at heights of up to 30 feet above the water level. Slicks which seemed to be oil but by chemical analysis were not were discriminated by the Monitor in both laboratory and field studies. The instrument provides a simple oil/no oil alarm and requires no attendant or cleaning problems. The possible applications of this instrument include: baseline studies of coastal oil slicks; monitoring of petroleum loading/unloading docks for minor spills; detection of oil which might be released into the environment from waste water storage tanks; and monitoring for law enforcement purposes suspected oil dumping or seepage areas.

*Oil Pollution, *Monitoring, *Instrumentation, Oil spills, Oceans, Coasts, Laboratory tests, On-site tests

Oil films, Infrared reflection, Infrared Oil Film Monitor

E011
ESTIMATES USING FLUORESCENCE SPECTROSCOPY OF THE PRESENT STATE OF PETROLEUM HYDROCARBON CONTAMINATION IN THE WATER COLUMN OF THE NORTHWEST ATLANTIC OCEAN,

Gordon, D. C., Jr., Keizer, P. D., and Dale, J.

Department of the Environment, Fisheries and Marine Service,
Marine Ecology Laboratory,
Dartmouth, Nova Scotia, Canada

Marine Chemistry, Vol. 2, p 251-261, 1974. 1 fig, 2 tab, 24 ref.

Recent attention has been given to determining the magnitude and variability of petroleum hydrocarbon concentrations in and on seawater. Sampling was done from cruises in the water column of the northwest Atlantic Ocean between Nova Scotia and Bermuda, Canada. Fluorescence spectroscopy was used to estimate petroleum hydrocarbons concentrations. In surface water (0 to 3 mm) concentrations averaged 20.4 micrograms/liter; in water from 1 to 5 m they averaged 0.8 to 0.4 micrograms/liter. No significant concentrations were detected in deeper water. Variability indicated that distribution of oil in seawater is very patchy, particularly for surface waters. Due to adsorption problems seawater samples for hydrocarbon analysis cannot be collected by conventional sampling methods. The inner surfaces of the samplers must come in contact only with the water being sampled and must be rinsed with organic solvent after samples are removed. For this reason, previous work in the data analysis of seawater hydrocarbons should be re-examined.

*Oil pollution, Canada, Spectroscopy, Surface waters, Atlantic Ocean, Data analysis, Sea water, Sampling, Fluorescence

*Hydrocarbons, *Fluorescence spectroscopy

E012
FLOW PHOTOMETER (DURCHFLUSS-PHOTOMETER),

Galvanotechnik, Vol. 65, No. 9, p 611, July, 1974. 1 fig.

A flow photometer was designed by the Bruno Large Company of Duesseldorf, West Germany, for the continuous control of the turbidity of water and waste water. Based on the light scattering principle, the photometer uses a beam deviated by 90 degrees for the detection of turbidity-generating particles by the Tyndall effect. The possible soiling of the cuvette is compensated for by an extra beam going directly through the cuvette. Kieselguhr or formacin solution can be used for calibration.

*Analytical techniques, *Instrumentation, *Turbidity, Photometry, Design, Waste water, Calibrations, Water analysis

*Flow photometer

E013
THE DETERMINATION OF MERCURY IN WATER SAMPLES FROM THE ENVIRONMENT BY NEUTRON ACTIVATION ANALYSIS,

Van der Sloot, H. A., and Das, H. A.

Stichting Reactor Centrum Nederland,
Petten, The Netherlands

Analytica Chimica Acta, Vol. 73, No. 2, p 235-244, 1974. 6 fig, 2 tab, 13 ref.

A sensitive method for determining even small changes in the mercury content of natural waters is essential for pollution control. A method using neutron activation analysis to determine mercury in water samples from the environment is detailed. A distinction is made between inorganic, organic and particulate mercury. To determine inorganic mercury, the element is isolated by reduction and volatilization, followed by absorption on a charcoal column. To determine total mercury content of the water with and without suspended solids, the method of absorption from the solution onto a column of charcoal is used. The thermal neutron activation analysis is utilized to measure the mercury on the absorber, to a limit of detection of one ng per liter to the minus one. The method is applicable to both sea water and surface waters.

*Mercury, *Analytical techniques, *Neutron activation analysis, *Pollutant identification, Surface waters, Sampling, Measurement

Charcoal absorber

E014
TLC FINDS HEXANE SOLUBLES,

Atanus, H.

Western Electric
Hawthorne Works,
Chicago, Illinois

Water and Wastes Engineering, Vol. 11, No. 10, p 26, 28, October, 1974. 4 fig, 1 tab.

An analysis by thin layer chromatography of hexane solubles is described, for the detection of oil wastes in outfalls from plant discharges. The Metropolitan Sanitary District of Chicago conducts source sampling, direct measurement of waste water from each industrial complex in its area. If wastes are to be discharged into the sewage system, the limit of the amount of oil must be under 100 mg/liter. Oil is usually removed by standard techniques, such as skimming settling tanks and filtration before releasing treated sewer effluents. To identify and separate some of the hexane solubles (those relatively non-volatile organic material soluble in hexane), the thin layer chromatography method is utilized. A small quantity of hexane solubles is placed near the edge of a plastic or glass sheet coated with silica gel sorbent. When the glass is placed in an appropriate mixture of solvents, the solvents travel up the coated sheet with different affinities of the sample constituents travelling different distances. Separated components may be visualized with ultraviolet light or color-forming chemical reactions. Spotter solvents for detecting specific organic mixtures were: petroleum ether, ethyl acetate, acetic acid; petroleum ether, ethyl acetate, ammonium hydroxide; and benzene, methyl alcohol, ammonium hydroxide. Good separations were obtained by this method, without the use of costly or sophisticated equipment. Concentrations were measurable at the nanogram to the milligram level, and the technique is portable.

*Analytical techniques, *Pollutant identification, *Oil wastes, Chromatography, Sampling, Industrial wastes, Costs

E015
DETERMINATION OF THE AMMONIUM CONTENT IN WASTE WATERS BY MEANS OF THE AIR-GAP ELECTRODE,

Ruzicka, J., Hansen, E. H. Bisgaard, P., and Reymann, E.

Denmark Technical University, Lyngby, Denmark, Chemistry Department A

Analytica Chimica Acta, Vol. 72, No. 1, p 215-219, September, 1974. 1 tab, 11 ref.

The indophenol method has been recommended for the determination of ammonia in an aqueous solution. However, this method is time-consuming and subject to serious interference from mercury and iron ions and soluble sulphides. To minimize sample handling and the likelihood of contamination and to avoid the interferences of the indophenol method, ammonia-specific electrodes have been developed. The basic principle of these electrodes is the use of a hydrophobic gas-permeable membrane which separates the alkaline test solution from an internal solution of ammonium chloride of fixed molarity and the immersion of a glass pH electrode and a reference electrode in the internal solution. The air-gap electrode is similar to other gas sensors but the gas-permeable membrane is replaced by an air gap which separates the electrolyte layer from the sample solution. The greatest advantage of the air-gap electrode is that the electrode is never in direct contact with the sample solution. Instead the electrolyte is adsorbed as a very thin film on the surface of the indicator electrode. Additional advantages include simplicity of design, ease of renewal of the electrolyte, and fast response.

*Analytical techniques, *Ammonia, *Equipment, *Water analysis, Pollutant identification, Electrodes, Electrolytes, Water quality control

Air-gap electrode, Indophenol method

E016
TWO NEW WATER MONITORS AVAILABLE,

Chemical and Engineering News, Vol. 52, No. 42, p 33-34, October 21, 1974.

Two new water pollution monitoring instruments have recently been developed. The first is a portable, inexpensive chlorine detector, used for measuring instantaneous chlorine levels in all aquatic environments. It was produced by the National Bureau of Standards, and will detect total chlorine in the parts-per-billion range, an extremely sensitive measurement. This NBS chlorine monitor may be used for wildlife protection as well as to measure effectiveness of municipal water treatment plants and waste water plants. The second water pollution monitoring instrumentation is an elaborate system introduced by Philips Electronic Instruments. This system automatically provides for continuous surveillance of up to seven water quality parameters, including redox potential, pH, pCl, dissolved oxygen concentration, electrical conductivity, temperature, and turbidity. The station can be programmed to operate unattended for up to five weeks, or it can feed data directly into a processing station by way of a communications network. The Philips water monitoring station has the unusual feature of automatic cleaning of its sensors regularly with an ultrasonic cleaner. In addition to the use of this monitoring system by itself, it is suggested that greater potential might be achieved in water quality control with an integrated network of stations to monitor regional and perhaps national water characteristics.

*Monitoring, *Instrumentation, *Water quality control, *Chlorine, Aquatic environments, Water treatment, Waste water treatment, Regional analysis

National Bureau of Standards, Ultrasonic cleaning

E017
A NEW METHOD OF MEASURING THE OXYGEN DEMAND OF WATER,

Butzelaar, P. F., and Hoogeveen, L. P. J.

Philips Research Laboratories,
Eindhoven, The Netherlands

Philips Technical Review, Vol. 34, No. 5/6, p 123-128, 1974. 4 fig.

A fast and automatic method of measuring chemical oxygen demand has been developed. This gives the amount of oxygen needed for the complete oxidation of organic matter present in surface water. The quantity indicates the amount of oxygen that should be added to the water to compensate for the consumption of oxygen in biodegradation of organic matter. The COD value is determined by measuring the quantity of oxygen used up when a sample of water is oxidized at 900 C with oxygen in a constant carrier-gas flow in the presence of platinum. The oxygen is supplied by a zirconia cell, which keeps its partial pressure constant. Carrier gas is passed through another zirconia cell. The electric current used to restore the value in the second cell to the value of the original cell is a measure of the quantity of oxygen used up in oxidation of the water sample. This method of analysis lasts only two minutes, as compared with several hours for traditional COD measurements. Applications of this measurement are in monitoring networks and control circuits for water treatment plants, and the system may be easily automated.

*Automation, *Chemical oxygen demand, *Oxygen, Measurement, Biodegradation, Oxygen demand, Organic matter, Water treatment, Analytical techniques, Water sampling, Monitoring

Zirconia

E018
DETERMINATION OF NON-IONOGENIC SURFACTANTS IN WASTEWATERS BY THIN-LAYER CHROMATOGRAPHIC METHOD (Opredeleniye neionogennykh poverkhnostno aktivnykh veshchestv v stochnykh vodakh metodom khromatografii v tonkom sloye),

Yudina, N. M., and Cherkasskiy, A. A.

Zavodskaya Laboratoriya, Vol. 40, No. 6, p 642-644, 1974. 1 fig, 2 tab, 4 ref.

Extraction and a thin-layer chromatographic method for the quantitative determination of non-ionogenic surfactants, such as oxyethylated dodecyl alcohol, oxyalkylated dodecyl alcohol, polyoxyethylated polyoxypropylene glycol, polyoxyethylated polyoxyethylene diamine, and oxyethylated amides of synthetic fatty acids of the C10-C16 fraction, in industrial as well as other waste waters are described. Following extractive enrichment by means of chloroform at a recovery rate of 95-98%, the extract is applied on alumina layer, and 50:1.5 ratio of chloroform and ethanol is used as eluent. The spots are visualized by means of Draggendorf's reagent.

*Extraction, *Surfactants, *Analytical techniques, Waste water, Chromatography

Thin-layer chromatography, Eluents

E019
DIRECT ANALYSIS OF WATER SAMPLES FOR ORGANIC POLLUTANTS WITH GAS-CHROMATOGRAPHY-MASS SPECTROMETRY,

Harris, L. E., Budde, W. L., and Eichelberger, J. W.

Environmental Protection Agency,
National Environmental Research Center
Methods Development and Quality Assurance Research Laboratory
Cincinatti, Ohio

Analytical Chemistry, Vol. 46, No. 13, p 1912-1917, November, 1974. 4 fig, 2 tab, 7 ref.

Computerized gas chromatography-mass spectrometry (GC/MS) analysis for organic water pollutants offers an accurate and instant analytical technique. The applicability of a direct aqueous injection GC/MS procedure as a supplement to conventional solvent extraction for analysis of the organic pollutants in water and waste water samples was examined. Numerous water samples were collected from waste effluents, chemical spills, and waste treatment plants and submitted to this method. From each peak of a chromatogram, a mass spectrum was retrieved and gave an unequivocal identification of the pollutants still present in its effluent. Studies were also made of the effects of relatively large pressures of water vapor on the well established electron impact fragmentation patterns, quadrupole GC/MS system performance, interactive background subtraction, and detection limits. It was concluded that direct aqueous analysis is a useful supplementary procedure for detection of volatile compounds that are not found with solvent extraction.

*Mass spectrometry, *Gas chromatography, *Computers, *Pollutant identification, Water samples, Analytical techniques, Waste treatment, Effluents, Water vapor, Solvent extractions

*Organic pollutants

E020
DETERMINATION OF HEAVY METALS IN MUNICIPAL SEWAGE PLANT SLUDGES BY NEUTRON ACTIVATION ANALYSIS,

Weaver, J. N., Hanson, A., McGaughey, J., and Steinkruger, F. J.

North Carolina State University,
Raleigh, North Carolina,
Nuclear Services Laboratory,
Nuclear Engineering Division

Water, Air, and Soil Pollution, Vol. 3, No. 3, p 327-335, September, 1974. 5 fig, 3 tab, 10 ref.

Six North Carolina cities of varying sizes and degrees of industrialization were compared in terms of trace metal content of their sewage sludges. The method used was Neutron Activation Analysis, using a Low Energy Photon Detector. The knowledge of trace metal concentrations has application in: determining whether industrialized municipal sludge is polluted by industrial sources which are exceeding the effluent limits on heavy metals set up by the EPA; determining the effect of urban runoff by analysis of a basically rural municipal sludge; detecting the gradual build-up of heavy metals which could indicate future inhibition of the bacterial action on the sewage treatment; assessing the potential environmental hazards posed by use of such sludges by farmers; and determining possible air pollution problems associated with final disposal of such sludges by burning in sludge incinerators. The metals of particular interest were Hg, Se, Cr, Sb, Co and Fe. It was found that high levels of trace metals, including heavy metals, do exist in certain sewage sludges from North Carolina municipal treatment plants, and are likely to exist in other United States cities. With the use of Neutron Activation Analysis as a multi-element analytical scanning tool, however, most of the pollution problems associated with these sludges could be traced and removed.

*Analytical techniques, *Sewage sludge, *Neutron activation analysis, Municipal wastes, Urban runoff, Water pollution effects, Sewage treatment, Pollutant identification

E021
FIELD TESTING OF CENTRIFUGAL WASTEWATER PUMPS,

Cardillo, P. E., and Eakins, W.

Clinton Bogert Associates, Incorporated,
Fort Lee, New Jersey

Public Works, Vol. 105, No. 12, p 55-57, December, 1974.
2 fig, 2 tab.

The preparation and procedures for testing centrifugal waste water pumps at the site of installation are described. Field performance of the pumps must be made by qualified personnel and in accordance with the test code of the Hydraulic Institute Standards. Variations should be expected between field test results and the manufacturer's shop test results because of the conditions of instrumentation and the degree of accuracy. Troubles which may occur with the pump and their probable causes are outlined; problems include failure of the pump to deliver liquid, insufficient capacity, insufficient discharge pressure, pump overloading driver, pump vibrating, and noise in the pump. Preparation for testing involves checking the alignment of the pump and driver, checking the motor rotor for binding, and priming the pump. Instruments such as the pressure gauges, rpm counter, and watt-megger should be calibrated for accuracy. In the actual field test of the pump, it should be started with a closed discharge valve; then the valve should be slowly opened. Observations of proper stuffing box location, noises in pump or motor, vibrations in the pump, motor, or piping, and leaks in piping should be made. Readings should then be taken of vertical distance between suction and discharge gauges, suction gauge reading, discharge gauge reading, flow, and the power input to the motor measured at the motor. A standard for this entitled "Centrifugal Pumps Test Code" is available from the Hydraulic Institute to record data for each pump tested.

*Pumps, *Waste water treatment, *On-site investigations, *Centrifugal pumps, Equipment, Pumping

Field tests, Hydraulic Institute

E022
F2 COLIPHAGE AS TRACER IN WASTEWATER BASIN,

Kawata, K., and Olivieri, V. P.

John Hopkins University,
Baltimore, Maryland,
Department of Environmental Health

Journal of the Environmental Engineering Division, ASCE, Vol. 100, No. EE6, p 1307-1310, December, 1974. 1 fig, 6 ref.

Various types of chemical tracers have been used to determine actual rather than theoretical flow-through times in sedimentation basins for waste water treatment. As an alternative, the use of the biological tracer, f2 coliphage was investigated. This virus is often used as a model virus and can be grown in the laboratory with little difficulties to very high concentrations. Its assay is relatively uncomplicated, and there are normally very few male strains of the host of this virus to be found in community waste water. It was concluded that f2 is a suitable tracer to determine virus flow-through in a basin. When virus study was conducted in waste water unit processes, the use of the f2 coliphage for determination of flow-through time was convenient and gave little difficulty.

*Tracers, *Waste water, Basins, Sedimentation basins (waste disposal), municipal wastes, Viruses

*f2 Coliphage, Biological tracers

E023
AUTONOMOUS, AUTOMATIC APPARATUS FOR WATER POLLUTION CONTROL
(APPARECCHIO PER IL CONTROLLO AUTOMATICO DEGLI INQUINAMENTI
DELL'ACQUA CON AUTONOMIA DI FUNZIOAMENTO),

Inquinamento Acqua Aria Suolo, Vol. 16, No. 6, p 11, June, 1974.

An automatic apparatus developed by a British company for the continuous measurement and recording of the dissolved oxygen content and the water temperature in rivers, sewers, canals, lakes and basins is described. The battery-powered unit is suitable for autonomous operation for up to six weeks, with the battery having to be changed once a week. The apparatus is portable and can be implanted at depths of up to 30 meters. The measuring intervals can be selected between one minute and two hours by means of a built-in timer. The measurement data is recorded numerically.

*Automation, *Measurement, *Dissolved oxygen, *Water temperature, Instrumentation, Data collections

E024
CONTAMINATION OF WATER BY SYNTHETIC POLYMER TUBES,

Jung, G. A., Svec, H. J., Vick, R. D., and Avery, M. J.

Iowa State University,
Ames, Iowa,
Department of Chemistry

Environmental Science and Technology, Vol. 8, No. 13, p 1100-1106, December, 1974.
4 fig, 3 tab, 44 ref.

An accurate method for testing polymer tubes intended for use in situations which require flowing water or water solutions is described. Identifications of polymer additives such as plasticizers were made by a combination of gas chromatography-mass spectrometry. Contaminants in effluent water were isolated by sorption on macroreticular resin beads, contained in a small glass column. These sorbed organic compounds were then eluted with diethylether, the eluate was concentrated by evaporation, and the organic contaminants were separated and measured quantitatively by gas chromatography. The results showed detection of organic contamination ranging from one to 5000 parts per billion by weight where water had flowed through tubes of polyethylene, polypropylene, black latex, six different formulations of polyvinylchloride, and plastic garden hose.

*Gas chromatography, *Mass spectrometry, *Polymers, *Plastics, Water pollution, Analytical techniques, Construction materials

*Organic contamination, Polyethylene, Polyvinylchloride

E025
FILM TRANSPORT COEFFICIENT IN AGITATED SUSPENSIONS OF ACTIVATED CARBON,

Letterman, R. D., Quon, J. E., and Gemmell, R. S.

Northwestern University,
Evanston, Illinois,
Environmental Health Engineering Department

Journal of the Water Pollution Control Federation, Vol. 46, No. 11, p 2536-2546, November, 1974. 7 fig, 2 tab, 13 ref.

Adsorption equilibrium and kinetics must be understood for effective application of the activated carbon process for the removal of dissolved organic substances from water and waste water. The rate of uptake of phenol from dilute aqueous solutions by activated carbon particles was studied by using an agitated batch system. The effects of the initial phenol concentration and particle size on the uptake rate when extra-particle resistance to mass transfer is controlling were noted. Film transport coefficients were determined. The uptake of phenol may be described by the dimensionless expressions of either the Gilliland-Sherwood or the Froessling type. The film transport coefficient and its relationship to variables in the system, when it is correlated by the use of the Sherwood, Schmidt, and the specific power numbers was found to be independent of vessel geometry, impeller geometry, and impeller rotational speed. For the phenol carbon system, the film transport coefficient was shown to vary with the specific power input to the 0.149 power and with the particle diameter to the -0.348 power.

*Activated carbon, *Adsorption, *Phenols, Organic compounds, Kinetics, Mathematical studies, Waste water, Waste disposal

*Film transport coefficient, Gilliland Sherwood, Froessling

E026
WASTE WATER LEVEL MEASUREMENT,

Process Biochemistry, p 22, October, 1974.

A new precision instrument has been designed for measurement of waste water levels in sewers. Portacel, Limited is marketing the Dipper, which relies for its measurement accuracy on an electrically-activated non-corroding thin steel probe. The probe is lowered into a manhole on a 25-ft length of wire until it touches the surface of the water. The probe withdraws automatically to just above the surface, then again touches the water and repeats the withdrawal, every five seconds. Changes in the rise and fall of the water level are recorded on a circular graph chart. Readings may be provided for a 24-hour period or for a seven day period. The dipper is available in two models, one for permanent installation and one portable. Each is powered by a rechargeable 12-V wet battery, contained within specially designed equipment which clamps to the sides of the sewer shaft just below the manhole. Uses of this instrument include location and isolation of sections in sewer systems where wet weather infiltration is a problem. As a portable piece of equipment, the Dipper can be used to test both existing lines and to determine sewerage requirements of new and planned projects.

*Instrumentation, *Sewers, *Waste water, *Measurement, Automation, Manholes, Analytical techniques, Equipment, Planning

Waste water levels, Dipper

E027
INSTRUMENTATION FOR FILTRATION TESTS,

Kinsman, S.

Coulter Electronics, Incorporated,
Hialeah, Florida

Chemical Engineering Progress, Vol. 70, No. 12, p 48-51, December, 1974. 2 fig, 13 ref.

The use of modern electronics has added sophistication to filtering devices. While microscope slides have been used for counting and sizing particles for filter evaluation, statistical variation, human error, and lack of speed make this method unattractive. Photometers, such as turbidimeters and nephelometers have been an on-stream method of filter testing. They sense and measure a form of light passed through liquid suspending a particulate, as an indication of the mass of the suspended particles. Another technology, involving electronics and automation, is the use of one-by-one particle counters for filter testing. Analysis time is minimal, and computer evaluated results are produced directly from the instrument. Particles being counted are usually displayed on a video screen for visual evaluation of the sample. The particles are sampled directly from a liquid suspension for counting and sizing. The particle suspension is formed through a critical volume where particles are detected individually. Three forms of critical volume detection are light scatter, light interruption, and Coulter principle or electric current flow interruption. Instruments manufactured by the Royco Instrument Company and the Climet Corporation for light scattering are described. A light interference instrument is available from Hiac, Division of Pacific Scientific Company, and a Coulter principle instrument is made by Coulter Electronics Incorporated. Results obtained from one-by-one particle counters are dependent upon representative sampling of the test suspension, proper dispersion of the dust samples and reproducibility of instrument calibration.

*Instrumentation, *Filtration, *Photometers, Suspended solids, Particle size, Sampling, Calibrations, Electronic equipment, Automation

*Particle count, Filter testing, Particle suspension, One-by-one particle counters

E028
DETERMINATION OF CHLORINE-CONTAINING ORGANICS IN CHLORINATED SEWAGE EFFLUENTS BY COUPLED 36CL TRACER--HIGH RESOLUTION CHROMATOGRAPHY,

Jolley, R. L.

Oak Ridge National Laboratory
Oak Ridge, Tennessee

Environmental Letters, Vol. 7, No. 4, p 321-340, 1974. 6 fig, 3 tab, 58 ref.

Concern has been expressed that chlorination of effluents from sewage treatment plants for disinfection may yield stable chlorine-containing organic compounds which have undesirable environmental effects. To study the effects of chlorination on sewage and sewage treatment plant effluents, an investigation was conducted. This method involved combining radioactive tracer (36Cl) chlorination with high-resolution chromatography. By this technique, over 40 chlorine-containing organic compounds were separated from a chlorinated primary effluent (chlorine residual 2 mg/liter) of a domestic sanitary sewage treatment plant. Secondary effluents were investigated separately, and appear to have lower concentrations of these organic constituents. Toxicity effects of the organic compounds on both microorganisms and higher organisms have yet to be determined.

*Sewage treatment, *Chlorine, *Organic compounds, *Radioactive tracers, Chromatography, Pollutant identification, Effluents, Toxicity

Chlorine residuals, Sewage effluents

E029
METHODS FOR THE DETERMINATION OF SPECIFIC ORGANIC POLLUTANTS IN WATER AND WASTE WATER,

Lichtenberg, J. J.

Methods Development and Quality Assurance Research Laboratory, National Environmental Research Center, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio

IEEE Transactions on Nuclear Science, Vol. NS-22, No. 2, p 874-891, April, 1975. 15 fig, 57 ref.

Methods for sample collection and pretreatment and for isolation and determination of specific organic compounds are reviewed. Methods presented include those designed for the determination of organochlorine, organophosphorus, and organonitrogen pesticides, phenoxy acid herbicides, polychlorinated biphenyls, organic solvents and other selected organic compounds. Gas chromatography is the most widely applicable and popular method for detecting and measuring specific organic compounds in water, waste water, and other environmental media. When gas chromatography is used with selective detectors it is the most sensitive and selective method for qualitative and quantitative determination of organic compounds that is available. The absolute identification of compounds that can be only tentatively identified by other means is made possible by the recent development and application of the computer-controlled gas chromatograph-mass spectrometer. Examples of the application of infrared, ultraviolet, and fluorescent spectroscopy; liquid chromatography; and thin-layer chromatography for organic analyses are also discussed.

*Monitoring, *Analytical techniques, *Pollutant identification, *Gas chromatography, Spectroscopy, Chromatography, Pesticides, Organic wastes

E030
A MODIFIED PROCEDURE FOR THE DETERMINATION OF PHOSPHORUS IN DETERGENTS,

Goulden, P. D., and Holton, M. C.

Environmental Management Service, Department of the Environment, Ottawa, Ontario, Canada

Environmental Protection Service Report No. EPS 4-WP-74-2, March, 1974. 20 p, 9 fig, 1 tab, 2 ref, 1 append.

The Canada Water Act has led to regulations that limit the amount of phosphorus that can be present in laundry detergents made in or imported into Canada to 5% P205. The regulations also state that the method of analysis shall be that designed by the American Society for Testing and Materials. The latest ASTM method published (ASTM D820-72) was tested for its reliability. It was concluded that two problems exist in the ASTM procedure and that this procedure is not a satisfactory method for the analysis of phosphorus in detergents at the 5% P205 level. The problems encountered were that in the presence of the electrolyte from the detergent and the digestion-neutralization procedure, titration between two fixed pH's does not have a valid measure of the normality of a weak-acid solution; and, that there exists potential interference from carbonate carried in with the sodium hydroxide. A modified titrimetric procedure was developed which overcomes the problems experienced with the ASTM procedure for determining phosphorus content at low (5% P205) levels.

*Phosphorus, *Analytical techniques, *Detergents, *Analysis, Laboratory tests, Standards, Regulation, Pollutnat identification, Canada

*American Society for Testing and Materials, Canada Water Act

E031
APPLICATIONS OF TOXICITY TESTING TO SEWAGE-TREATMENT PROCESSES,

Green, M. B., Willetts, D. G., Bennett, M., Crowther, R. F., and Bourton, J.

Water Pollution Control, Vol. 74, No. 1, p 40-58, 1975. 13 fig, 8 tab, 15 ref.

Certain compounds present in industrial effluents are known to disrupt some of the biological stages of sewage treatment. Routine biological inspection of filters in the Upper Tame Main Drainage Authority area of Trent, Great Britain, indicated that filters at certain sewage treatment works had sparse populations of grazing invertebrates. The toxicity of sewage to macro invertebrates such as the enchytraeid worm Lumbricillus rivalis was tested. Applications of toxicity testing involve: measurement of compounds which are known to be deleterious to some extent and which are a usual feature of industrial effluent control, such as heavy metals in both aerobic and anaerobic treatment; industrial waste waters which are not readily controlled by limits determined by conventional analyses; and screening of newly-marketed formulations which might be present in sewage. Laboratory-scale activated sludge units and respirometric techniques were described. It was concluded that the application of toxicity testing to sewage treatment is a valuable method of re-assessing industrial effluent charges and of evaluating acceptable concentrations of certain wastes. Simple screening-test facilities are also useful to check and monitor problems concerning materials being discharged to a sewer. The techniques described are appropriate to the scale of sensitivity required for sewage treatment quality; for discharge of final effluent on watercourses, a higher level of sensitivity would be needed.

*Biological treatment, *Sewage treatment, *Toxicity, Laboratory investigation, Invertebrates, Water quality control, Effluents, Aerobic treatment, Waste water treatment

Enchytraeid worms, Screening

E032
A NEW DIRECT ULTRAVIOLET METHOD FOR THE ANALYSIS OF NITRATE IONS,

Moore, J. C.

Effluent and Water Treatment Journal, Vol. 15, No. 1, p 17-20, January, 1975. 10 fig.

A method of direct ultraviolet analysis of nitrate nitrogen is compared with a conventional analysis method which uses brucine sulphate. The brucine sulphate method requires special precautions because of its toxicity, involves precise timing and temperature, and is not accurate in clean water situations because its minimum detectable concentration is 0.18 mg/liter for a one cm path length cell at 410 nm. On the other hand, the ultraviolet method is based on the nitrate absorbance maximum at 203 nm. At concentrations of nitrate ions up to 0.5 mg/liter, the two methods performed identically. However, while stream water from lakes produced excellent results by the direct UV method, the brucine sulphate method was not applicable due to lack of sensitivity. Results were also compared for analysis of influent and effluent of a water pollution control center. The plant utilized activated sludge and trickling filters, reduced organic content by 90%, and accomplished nitrification. Both methods produced similar data; accuracy of the UV method increased with decreasing organic content. Because the direct UV method requires very low organic material, the organic content may be reduced substantially by preliminary precipitation with barium hydroxide and zinc sulphate, improving the applicability of this technique for water analysis. The main disadvantage of the direct UV method had previously been the lack of an inexpensive single beam in instrumentation for use at lower wavelengths. Recently, however, lower wavelengths and narrower bandpass have become available.

*Nitrates, *Nitrification, *Ultraviolet radiation, Analytical techniques, Lakes, Waste treatment, Organic compounds, Toxicity

E033
THE MAGNETIC FLOWMETER AND ITS USE IN WASTE WATER TECHNOLOGY (DER MAGNETISCHE DURCHFLUSSMESSER UND SEINE ANWENDUNG IN DER ABWASSERTECHNIK),

Fieberg, D.

Gas-Wasser-Fach Wasser/Abwasser, Vol. 115, No. 10, p 463-467, October, 1974. 8 fig, 5 ref.

The advantages and uses of magnetic flowmeters in waste water technology are described. Magnetic flowmeters cause no change in the flow cross-section, and the pressure drop generated by them equals that caused by a pipe of identical length. Magnetic flowmeters can be used reliably for the measurement of viscous liquids and liquids carrying solid materials. The readout is linear and is insensitive to voltage fluctuations up to ±15%. Magnetic flowmeters are designed for flow rates of up to 10 m/sec, with the lowest range being between zero and 1 m/sec. Non-conducting deposits on the pipe walls that could falsify the readout may be removed by ultrason or electric shock. Deposits whose conductivity are the same as that of the medium flowing through do not interfere with the measurements. However, magnetic flowmeters should be used in completely full pipes as partial flow falsifies the readout. Magnetic flowmeters can be efficiently used for the control of the waste water and return sludge in biological waste water treatment plants.

*Flow, *Measurement, *Waste water treatment, *Biological treatment, Flow rates, Liquids, Equipment, Treatment facilities, Instrumentation

*Magnetic flowmeter

E034
SOME APPLICATIONS OF THERMAL INFRA-RED LINESCAN IN WATER RESOURCES STUDIES,

Brereton, N. R., and Downing, R. A.

Water Research Centre, Medmenham,
Great Britain

Water Services, Vol. 79, No. 949, p 91-96, March, 1975. 3 fig, 1 tab, 5 ref.

The remote sensing method of thermal infra-red linescan has been applied in several regional studies concerned with the large scale development of groundwater resources. These studies were conducted to detect the location of groundwater discharges from the Chalk into the sea and to assess whether groundwater abstraction from a well field had any effect on vegetation or moisture content of the soil. Sewage outfalls were used as controls, with known temperatures and discharges, and it was found that the method was unlikely to detect springs smaller than 100 liters/s, even in shallow water. On the inland survey, it was shown that groundwater discharges to rivers can be detected providing that the temperature difference between the surface water and the groundwater is sufficient to create a recognizable thermal anomaly or if groundwater discharge is high enough to not be diluted by the surface water too rapidly. While the thermal infra-red linescan method was not suitable for small or diffuse groundwater flow, the method is most applicable for detection of temperature anomalies in large expanses of water which cannot be economically surveyed from the ground. In coastal surveys, this technique may also be useful for studying the mixing of river and sea waters and for detecting pollution.

*Groundwater, *Analytical techniques, Discharge (water), Surveys, Groundwater resources, Remote sensing, Pollutant identification, Regional analysis, Costs

E035
DETERMINATION OF NITRATE IN WATER WITH AN AMMONIA PROBE,

Mertens, J., Van den Winkel, P., and Massart, D. L.

Analytical Chemistry, Vol. 47, No. 3, p 522-526, March, 1975. 6 fig, 6 tab, 24 ref.

Both manual and automatic procedures are described for the determination of nitrates in water containing ammonia by means of an ammonia probe. Nitrates were determined by the measurement of the amount of ammonia produced during a heterogeneous reduction by means of Devarda alloy powder. The yield of the nitrate reduction with the Devarda alloy was quantitative. This method was proven to be extremely accurate and reproducible; the procedure is applicable to waters ranging from mineral water to sewage. In addition, methodology for the elimination of excess ammonium and nitrite were proposed. Other reduction methods did not yield good results and the reasons for these are discussed.

*Nitrates, *Ammonia, *Analtyical techniques, Sewage, Measurement, Automation

Ammonia probe, Nitrate reduction, Devarda alloy

E036
ENERGY EVALUATION AND ORGANIC COMPOUND INDEX IN MUNICIPAL SEWAGE WATER,

Aida, T., Munemiya, I., and Kawamura, K.

Gesuido Kyokai-shi, Vol. 11, No. 127, p 21, December, 1974. 8 fig, 22 ref.

An equation to calculate an approximate BOD value was obtained from the thermodynamic consideration based on the enthalpy change in oxidation reactions of organic compounds. The equation obtained was that the BOD was equal to 0.146 times the enthalpy change of organic compounds. The applicability of the equation to the actual sewage water samples is determined by analyzing the BOD values of samples collected at two different cities by the sodium oxide method. The calculated BOD values were found to agree with the observed values for untreated sewage water; however, they did not agree for treated sewage water. This indicates that highly undecomposable oxidation products contributed to the observed BOD values. Therefore a constant term was necessary to be added to the equation, depending on the sewage plants. A similar thermodynamic consideration was made for TOD calculation; its correlation with BOD was 0.502. For the same sewage water samples, the COD and TOC values were also analyzed and the average correlation factors of BOD to COD and TOC were obtained as 0.5 and 1.3 respectively.

*Municipal wastes, *Sewage treatment, *Sampling, Biochemical oxygen demand, Organic compounds, Oxidation

Enthalpy change, Organic compound index, Thermodynamics

E037
AN AUTOMATED METHOD FOR DETERMINATION OF RESIDUAL METHANOL IN DENITRIFIED EFFLUENTS,

Musselwhite, C. C.

Water Research Centre,
Stevenage, Herts,
Great Britain

Water Pollution Control, Vol. 74, No. 1, p 110-111, 1975. 1 fig, 2 tab, 2 ref.

An automated method has been developed to determine the amount of residual methanol in denitrified effluents. Biological denitrification of effluents is used to reduce the oxidized nitrogen content of effluents which are discharged to rivers. Methanol is currently used as a carbon source when nitrified effluents are deficient in biodegradable organic carbon. Pilot plant studies have been conducted using methanol for denitrification at the Stevenage Laboratory of the Water Research Centre. For economical and efficient use of methanol, its concentration should be monitored in denitrified effluents. A Technicon Auto Analyzer and its procedure are described. The method is based on the oxidation of methanol to formaldehyde, determined colorimetrically after reaction with acetylacetone. The method was proven suitable for monitoring residual methanol either in discrete samples or continuously in denitrified effluents. Correction for interference in the measurements of peaks may be necessary in some instances, and the method is applicable to a wide range of sewage samples.

*Automation, *Waste water treatment, *Denitrification, Monitoring, Sewage treatment, Oxidation, Pilot plants, Costs, Effluents, Rivers, Analytical techniques

*Methanol, Technicon Auto Analyzer, Residual method

E038
THE UTILIZATION OF TRACERS IN THE STUDY AND CONTROL OF WATER POLLUTION (UTILIZACAO DE MARCADORES NO ESTUDO E CONTROLE DE POLUICAO DAS AGUAS),

Bau, J.

Laboratorio Nacional de Engenharia Civil, p 5-15, 1974. 22 ref.

Chemical, radioactive, and fluorescent tracers and their uses in general hydrological and water pollution studies are reviewed. Compounds of chromium, sodium, cobalt, indium, and tantalum are among the most frequently used chemical tracers. The most common radioactive tracers are 82Br, 130I, 192Ir, 182Ta, 51Cr, 198Au, and 110Ag. Fluorescent tracers, such as rhodamine-B, rhodamine-WT, and fluorescein, emit visible light due to the effect of UV irradiation. A literature review of studies and experiments using tracers is presented. Tracers are particularly suitable for the study of flow and dispersion processes in water, as well as the study of the dilution and general behavior of water pollutants.

*Tracers, Water pollution, Flow, Hydrologic aspects, Analytical techniques, Reviews

Chemical tracers, Radioactive tracers, Fluorescent tracers, Pollutant dispersion

E039
NEW FLOWMETER PASSES TESTS,

Daneker, J. R., and Koator, J. S.

General Signal Corporation,
West Warwick,
Rhode Island

Water and Wastes Engineering, Vol. 12, No. 4, p 58, 60, April, 1975.

A flowmeter for measuring solids-bearing fluids (SBF) has been tested for two and one-half years in waste water treatment plants in thirteen United States cities. Conditions were varied regarding metering application, line pressure, line size, and systems function. In all cases, the SBF was an extremely accurate device. It was found from the field tests that most municipalities experienced some problems with material build-up on the inside wall of their sludge lines; techniques to alleviate this have been employed. For example, the City of East Providence, Rhode Island recirculates flushing water, the East Bay Municipal Utility District in Oakland, California utilizes 140 F (warm) water for flushing, and Orange County, California uses extensive steaming at 250 F for four hours to keep their lines clean. Periodic maintenance for sewage treatment systems have also been minimized by using glass linings which are less susceptible to material buildup. The major advantage of the SBF system over previous fluids measuring devices is that field checking is easily accomplished. The primary instrument can be positively field checked using a manometer, and the sensors can be checked by visible means, comparing differential pressure output of the sensors against that of a manometer directly on the venturi. In addition, when the two differential pressures agree, the performance of the associated instrumentation is easily checked.

*Analytical techniques, *Instrumentation, *Flow measurement, Liquids, Maintenance, Equipment, Municipal water, Sewage treatment, Treatment facilities

*Solids-bearing fluids, *Flowmeter

E040
A RATIONAL APPROACH FOR PREDICTING THE DISSOLVED OXYGEN PROFILE IN RECEIVING WATERS,

Peil, K. M., and Gaudy, A. F., Jr.

Oklahoma State University,
Stillwater, Oklahoma,
School of Civil Engineering

Biotechnology and Bioengineering, Vol. 17, p 69-84, 1975. 9 fig. 14 ref.

A new method has been developed for predicting the dissolved oxygen profile in a stream receiving biodegradable wastes. Because the level of dissolved oxygen in a stream influences the health of the aquatic environment, the amount of organic materials removed from waste water should be carefully determined. Such an engineering prediction is among the most complex in the field of environmental bioengineering. For this method the BOD curve is obtained using an open jug technique. The accumulated O2 uptake curve is then used in numerical integration with physical reaeration data for the receiving stream in order to predict the DO profile in the stream. In this case, 10-liter open jar reactors were utilized to obtain the O2 uptake curves, and the receiving stream was a 670-liter simulated stream apparatus. A good prediction of the actual DO was obtained. The effect of the reaeration constant K2 (agitation effect) on the kinetics of O2 uptake was studied. It was found that increased agitation caused some increase in the BOD curve, with most of the increase coming after the plateau area in the O2 uptake curve, or after the low point along the DO sag curve.

*Analytical techniques, *Dissolved oxygen, *Waste disposal, Streams, Biochemical oxygen demand, Environmental effects, Waste water

Environmental bioengineering, Oxygen uptake curve, BOD curve, Reaeration

E041
RADIOMETRY OF WATER TURBIDITY MEASUREMENTS,

McCluney, W. R.

Journal of the Water Pollution Control Federation, Vol. 47, No. 2, p 252-266, February, 1975. 4 fig, 36 ref.

Turbidity has been used as a term for all water clarity measurements and techniques. A description of various types of equipment for such measurements is given. The two predominant classifications are those based on a comparison with standard suspensions of known turbidities and those based on absolute measurement of some optical quantity. Most of the turbidimeters should properly be called either transmissometers or scatterometers with proper calibrations. When used, their results are stated in terms of fundamental optical quantities such as c, k, b, a, or beta. Attempts to relate a given measurement of beta or c to the quantity of suspended materials present in a sample should be kept distinct from the optimal measurement itself. Economically, an ideal turbidity measuring instrument would be more expensive than a simpler and less accurate one. For this reason, a variety of available instruments with variable definitions of water clarity persist. Variations are due to detector acceptance, angle, shape of the scattering cell, and overall spectral response. In addition, nephelometric turbidimeters are laboratory instruments while most in situ devices are transmittance meters. Furthermore, manufacturers are reluctant to recalibrate or redesign instruments for more accurate measurement of one or more of the fundamental parameters of hydrologic optics.

*Turbidity, *Equipment, Analytical techniques, Suspended solids, Measurement, Instrumentation

*Water clarity measurement, Turbidimeters, Transmissometers

E042
GLC DETERMINATION OF PPB LEVELS OF CITRATE BY CONVERSION TO BROMOFORM,

Bjork, R. G.

Pfizer Incorporated,
Groton, Connecticut

Analytical Biochemistry, Vol. 63, p 80-86, 1975. 2 fig, 3 tab, 9 ref.

Citrate has been proposed for use as a builder in detergents. For this reason, its biodegradability and potential ecologic impact were evaluated. Citric acid may be determined at the parts per billion level in sewage effluents as well as in natural water bodies by gas chromatography with an EC detector, without prior sample preconcentration. The citrate is converted to bromoform through a pentabromoacetone intermediate. In obtaining a result, the various Kreb's cycle acids, amino acids, NTA, and citrate chelators were tested for possible interference. Only 3-oxopentanedioic acid, which is stoichiometrically converted to bromoform, was seen to interfere. The analytical method developed is useful to measure citric acid concentration as low as 10 parts per billion.

*Gas chromatography, *Analytical techniques, Environmental effects, Sewage effluents, Detergents

*Citrates, Citric acid, Bromoform

E043
WATER ANALYSIS,

Fishman, M. J., and Erdmann, D. E.

U. S. Geological Survey, Lakewood, Colorado

Analytical Chemistry, Vol. 47, No. 5, p 334-361, April, 1975. 660 ref.

An extensive literature review is presented of analytical chemistry methods applied to water analysis. The time period covered ranges from October 1972 through September 1974. The material used in preparing the review is mainly from major analytical journals and chemical abstracts. Methods are described which analyze water for the following constituents or parameters: alkali metals; hardness; alkaline earth metals; aluminum; iron; manganese; chromium; copper; zinc; lead; cadmium; nickel; cobalt; tin; mercury; silver; gold; molybdenum; vanadium; bismuth; uranium; thorium; rare earth metals; boron; selenium; arsenic; antimony; phosphorus; silica; halides; sulfate; sulfide; nitrate; ammonia; organic nitrogen; cyanide; pH; alkalinity; carbon dioxide; specific conductance; turbidity; oxygen and other gases; detergents; pesticides; herbicides; fungicides; organic pollutants; and, radioactive contaminants. The methods reviewed are suitable for examination of industrial and municipal effluents, and fresh, brackish, and salt water.

*Review, *Analytical techniques, *Water analysis, Organic pollutants, Analysis, Chemical analysis, Laboratory tests, Sampling

E044
SHORTCUT METHODS TEST ALGICIDES,

Fitzgerald, G. P.

Wisconsin University, Madison, Wisconsin

Water and Sewage Works, Vol. 121, No. 9, p 85-87, September, 1974. 5 tab, 12 ref.

Rapid methods have been developed to determine the effectiveness of algicide applications. The effectiveness of various algicides can be demonstrated within one day's time by measurements of the ability of the algae to absorb PO4-P; dead algae do not absorb phosphorus. The previous procedure involved waiting at least a week and measuring the algae growth. The procedures designed can be adapted to planktonic algae, filamentous algae, or aquatic plants. The procedure combines nutritional tests for phosphorus with algicide applications to determine the relative effectiveness of algicides. The effect of various dosages of chemicals over different time periods on the ability of algae to absorb phosphorus or the phosphorus content of the algae were correlated with the death of the algae as determined by growth tests. The results of experiments performed using different copper products as algicides showed that: this test could be utilized to evaluate the relative effectiveness of algicides under different environmental conditions such as duration of treatment, pH, water hardness, or the presence of silt or dissolved organic matter; either the concentration of algicide or the treatment duration can be regulated to produce an effective treatment; the source of copper used as the algicide will determine the treatment duration or concentration required for a particular level of effectiveness; and, the minimum amount of algicide to be effective is related to the amount of algae present and is not related to the volume in which the algae are suspended.

*Algae, *Algal control, *Algicides, *Copper, Analytical techniques, Algal toxins, Phosphorus, Water treatment, Copper compounds

E045
QUANTITATIVE LARGE-VOLUME SAMPLING TECHNIQUE,

Levin, M. A., Fischer, J. R., and Cabelli, V. J.

United States Environmental Protection Agency,
West Kingston, Rhode Island,
Northeast Water Supply Research Laboratory

Applied Microbiology, Vol. 28, No. 3, p 515-517, September, 1974. 2 fig, 2 tab, 8 ref.

A filtration technique for high-volume sampling (HVS) in water is described that can be used in combination with the most probable number technique (MPN) for the quantitation of microorganisms present at low densities. The apparatus consists of a Balston type AA cartridge filter, 2.5 by 6.4 cm, with a type 90 filter holder. The filter is made of borosilicate glass microfibers bonded with epoxy resin. It is 98% efficient for 0.3 micromillimeter particles. The HVS technique was used to obtain the MPN estimates of Salmonella densities in samples of marine waters aroun New York City, as a demonstration of this method. The HVS technique can be used in any sampling situation as long as a selective-enrichment medium is available for use in combination with the MPN procedure.

*Analytical techniques, *Bacteria, *Filtration, *Water analysis, Equipment, Laboratory tests, Pollutant identification, Filters

High-volume sampling, Most probable number

E046
COMPARISON OF AUTOCLAVE AND ETHYLENE OXIDE-STERILIZED MEMBRANE FILTERS USED IN WATER QUALITY STUDIES,

Dutka, B. J., Jackson, M. J., and Bell, J. B.

Canada Centre for Inland Waters, Burlington, Ontario,
Microbiology Laboratories

Applied Microbiology, Vol. 28, No. 3, p 474-480, September, 1974. 2 fig, 5 tab, 8 ref.

The acceptance of the membrane filter technique as an official method of evaluating water quality forces the microbiologist to decide which membrane filter to choose from a variety of commercially available filters, each with its own brand name and characteristics. Membrane filters manufactured by Gelman, Millipore, and Sartorius were autoclave and ethylene oxide-sterilized and field tested for their recovery of total coliforms, fecal coliforms, fecal streptococci, and heterotrophs. Toxicity studies were performed to determine whether the membranes had a toxic effect on Escherichia coli growing at 35 and 44.5 C. The data were analyzed by using split-plot analysis of variance and significance tests. Gelman membrane filters generally produced the highest bacterial counts. Toxicity tests at 35 C showed that Gelman and Millipore autoclaved membrane filters were able to recover 92% of the test organisms. There was an extremely poor recovery rate at 44.5 C. Sartorius membranes were found to have hydrophobic areas which reduced the actual filtering area. The Millipore and Sartorius membranes became distorted and somewhat fragile after autoclaving. The differences observed in the ability of the three brands of membrane filters to recover bacteria makes it apparent that the brands can not be used interchangeably and that there should be standardized methods for bacteriological testing of membrane filters.

*Water quality control, *Testing, *Bacteria, *Filters, Statistics, Standards, Sampling, Analytical techniques, Toxicity, Filters

*Membrane filters, Millipore, Gelman, Sartorius, Autoclaves

E047
ELEVATED TEMPERATURE TECHNIQUE FOR ENUMERATION OF SALMONELLAE IN SEWAGE,

Phirke, P. M.

Central Public Health Engineering Research Institute, Nagpur, India, Division of Microbiology

Indian Journal of Medical Research, Vol. 62, No. 6, June, 1974. 4 tab, 12 ref.

Isolation of microorganisms of the genus Salmonella from sewage and effluents from sewage treatment plants is difficult and enumeration of the bacteria is even more difficult. A quantitative method for determining Salmonella in sewage is described. The technique uses the most probable number method and incubation of the samples at an elevated temperature of 41.5 C in a selenite brilliant green enrichment broth. The broth is composed of mannitol, sodium taurocholate, sodium selenite, peptone, yeast extract, dipotassium phosphate, brilliant green, and distilled water. A sample of sewage was thoroughly homogenised by shaking and was sub-divided into seven portions. Each portion was treated as a separate sample and inoculated in duplicate sets. One set was incubated at 41.5 C and the other set was incubated at 37 C. The data indicate that enrichment at 37 C yields too low numbers. The results from 41.5 C technique are better, more consistent and reliable than the results from the 37 C temperature. The difference in Salmonella recovery may be due to the fact that at 37 C most of the interfering organisms grow faster and mask the growth of the Salmonella. However, at 41.5 C, Salmonella growth is enhanced and the growth of the interfering organisms is inhibited. This method for the determination and enumeration of Salmonella will be of value in assessing the effectiveness of sewage treatment plants in the removal of Salmonella bacteria.

*Salmonella, *Pathogenic bacteria, *Sewage treatment, *Analytical techniques, Pollutant identification, Bacteria, Cultures, Sewage bacteria, Water quality control, Sewage

Most probable number

E048
AUTOMATIC DEVICE FOR THE OPERATIONAL CONTROL OF THE FILTRATION RATE OF SUSPENSIONS (AUTOMATISCHE VORRICHTUNG ZUR TECHNISCHEN KONTROLLE DER FILTRATIONSGESCHWINDIGKEIT VON SUSPENSIONEN),

Zagrodzki, S.

Zeitschrift fuer die Zuckerindustrie, Vol. 24, No. 8, p 421-423, August, 1974. 1 fig, 10 ref.

The capacity of a suspension being filtered is frequently a decisive factor for the filtering process. Causes of difficulties encountered in the filtering process may be adverse structure of a precipitate or certain properties of a solution. Continuous control of the rate of filtration of suspensions enables measures to be taken rapidly, thus improving conditions in the processes preceding filtration. A device for automatic and continuous control of the capacity of suspensions for being filtered has been designed, constructed, and tested. The apparatus accurately measures the rate of filtration of suspensions through a filtration wall at a known pressure. The filtration wall may then be automatically washed and the rate of filtration of the next suspension portion measured.

*Filtration, *Automation, *Filtering systems, *Aqueous solutions, Design, Construction, Precipitation (chemical)

Suspensions

E049
RESEARCH ON POLLUTION WITH POLYCHLORINATED BIPHENYLS AND POLYCHLORINATED TERPHENYLS IN SEWAGE PLANTS,

Kawase, T., Tsuchiya, Y., Okamoto, Y., Yamazaki, K., and Mimura, S.

Tokyo Eisei Kenkyu Nenho, No. 25, p 411-416, 1974. 3 fig, 9 ref.

Research was conducted on pollution by polychlorinated biphenyls (PCBs), polychlorinated terphenyls (PCTs), and coprostanols in sewage treatment plants. When influents, effluents, and activated sludges of some sewage plants were examined, PCBs was detected in all three materials. The maximum value of PCBs was detected in a Ukima, Japan, plant where industrial waste water is treated. PCTs were detected in influents and activated sludges, but not in effluents. The PCTs/PCBs ratio in activated sludges had an average value of 1/17. No correlation between coprostanol and PCBs could be demonstrated; a very slight correlation exists between coprostanol and PCTs.

*Polychlorinated biphenyls, *Sewage treatment, *Waste water treatment, Water pollution, Activated sludge, Effluents, Influent streams, Industrial wastes

Polychlorinated terphenyls, Coprostanols, Japan

E050
WATER ANALYSIS OF RIVER WATERS IN KAGAWA (IX),

Itoyama, T.

Kagawa Daigaku Kyoiu Gakubu Kenkyu Hokoku, Vol. 2, No. 230, p. 1-7, 1974. 1 fig, 11 tab, 7 ref.

The differences in chemical composition of the groundwater and river water of the Aya Water basin, Japan, were investigated between May 1969 and January 1970. The geochemical study indicated that in the upper mountaneous district of the Aya Water basin, all measurement of chemical composition, including total hardness, Ca hardness, Cl, SiO2, and total residue, except for COD, were observed to be higher in the groundwater than in the river water. The weight ratios, groundwater to river water, total residue to total hardness, and Ca hardness to Cl hardness, were equal, respectively. Fluctuation of values of the chemical composition during a given year differed largely when groundwater was compared with river water.

*Analytical techniques, *Groundwater, *Rivers, *Chemical analysis, Geochemistry, Calcium

Aya Water basin (Japan)

E051
THE TOXICITY OF HEAVY METAL IONS TO ANAEROBIC DIGESTION,

Mosey, F. E., and Hughes, D. A.

Water Pollution Research Laboratory,
Department of the Environment,
Stevenage, Herts, Great Britain

Water Pollution Control, Vol. 74, No. 1, p 18-39, 1975. 16 fig, 2 tab, 10 ref.

It has been shown that certain heavy metal ions can inactivate enzymes by reacting with their sulphydryl groups, thus inhibiting the growth of organisms. It was implied that a relationship exists between the concentration of sulfide ions and the degree of inhibition by metals. This degree of inhibition must be ascertained for the control of anaerobic digesters. Sludge from detergent-free sewage was examined. Digesters were each charged with 2 liters of actively digesting sludge from a breeder digester and operated; solutions of various metal salts were each added 19 days later. Feed to each digester was 80 ml of raw sludge plus the required volume of a salt solution; the mixtures were then stirred and let stand for an hour. Rate of feeding corresponded to a mean period of detention of sludge in the digester of 20 days. Raw and digested sludges were analyzed and volumes of gases produced daily and per unit of volatile matter destroyed by digestion recorded. The silver/silver sulfide electrode was found to be a reliable analytical tool to measure pS values. A pS value over 14.0 in a digesting sludge indicated the presence of inhibitory concentrations of the heavy metal ions Zn++, Cd++, Fe++, Cu+, or Cu++, when oxidizing agents were absent. Neutralization of zinc toxicity by precipitation of zinc as zinc carbonate requires a pH value of about 7.6. Ferric ions are reduced to ferrous ions and cupric ions to cuprous ions during anaerobic digestion.

*Toxicity, *Heavy metals, *Anaerobic digestion, Sewage treatment, Sludge, Sulfides, Pollutant identification, Analytical techniques

E052
INTERRUPTED-SWEEP VOLTAMMETRY FOR THE IDENTIFICATION OF POLY-CHLORINATED BIPHENYLS AND NAPHTHALENES,

Farwell, S. O., Beland, F. A., and Geer, R. D.

Montana State University, Bozeman, Montana,
Department of Chemistry

Analytical Chemistry, Vol. 47, No. 6, p 895-903, May, 1975.

The use of interrupted-sweep voltammetry for the identification of polychlorinated hydrocarbons by characteristic current-voltage patterns and interrupt-potential data was demonstrated. The inexpensive instrumentation developed for this identification is particularly advantageous in obtaining rapid and reproducible voltametric data when the chlorinated hydrocarbon reduction waves overlap. The theoretical basis, design, operation, and "fingerprinting" capability of the equipment are discussed. The several important features of the interrupted-sweep technique that make it especially effective in the fingerprint identification of chlorinated hydrocarbons include: automatic control of the applied waveform by the reduction behavior of the sample; high resolution peaks; and, the relatively low cost of the integrated circuit instrumentation. Characteristic voltammetric fingerprints and reduction potential data were obtained for 31 polychlorinated biphenyls and 37 polychlorinated naphthalenes. Only two of the compounds could not be positively identified using this technique.

*Pollutant identification, *Analytical techniques, *Instrumentation, *Polychlorinated biphenyls, Water pollution sources, Pollutants, Equipment

*Polychlorinated naphthalenes, Polychlorinated hydrocarbons

E053
THE SOURCES AND LEVELS OF MERCURY IN THE SEWAGE OF A UNIVERSITY CAMPUS,

Cox, J. A., Lundquist, G. L., Webster, R. C., Cox, R. A., Lindahl, P. C., and Caskey, A. L.

Southern Illinois University,
Carbondale, Illinois,
Department of Chemistry and Biochemistry

Bulletin of Environmental Contamination and Toxicology, Vol. 13, No. 4, p 397-400, April, 1975. 1 tab, 9 ref.

While it has been assumed that mercury pollution originates from industrial sources, other data have indicated that purely domestic sources may also account for mercury levels in sewage. In this study, a University campus in Illinois was chosen for analysis of its sewerage. A three-month survey of the total level of mercury from the main outfall sewer of the central campus was made. From an average of 152 trials, a mercury level of 7.5 ppb greatly exceeded the Illinois Pollution Control Board sewer-discharge criterion. The high levels of mercury slugs originated primarily from laboratories which use mercury and its compounds. A program was then established which identified the mercury users on campus and informed these users of a system where the overall-university and individual-building sewer effluents would be monitored for mercury. A central laboratory was designated for reception and treatment of mercury-containing wastes. Following this program, the mean level of mercury was lowered to 0.83 ppb. Sewage solely from student housing contained mercury only slightly in excess of the established background level. Some slugs of mercury in the main-outfall sewer did not correlate directly to slugs from individual buildings; however, subtle sources of mercury occasionally discharged to sewers are as yet undetermined.

*Mercury, *Sewage, *Monitoring, Analytical techniques, Waste treatment, Pollutant identification, Water pollution sources, Illinois

E054
ESTIMATES OF OIL IN AQUATIC SEDIMENTS BY FLUORESCENCE SPECTROSCOPY,

Hargrave, B. R., and Phillips, G. A.

Department of the Environment, Fisheries and Marine Service,
Bedford Institute of Oceanography, Dartmouth, Nova Scotia,
Canada, Marine Ecology Laboratory

Environmental Pollution, Vol. 8, No. 3, p 193-215, April, 1975. 12 fig, 3 tab, 34 ref.

Fluorescence spectroscopy has been used to identify petroleum that has been spilled into the water and has become deposited in the sediments. Application of the fluorescence method for estimating oil in water, sediments and organisms requires that fluorescence be related to a standard. Wavelengths for measurement are chosen by scanning excitation and emission spectra and identifying peaks. Total oil concentrations are not measured, only inferred, and the use of such calibrations assumes that all fluorescence in samples is attributable to the presence of fluorescing compounds equivalent to those in the petroleum standard. A procedure for extracting aromatic containing compounds from sediments was developed in the present study. Fluorescence contour diagrams were constructed and used to compare fluorescence patterns in n-hexane extracts of samples and standard oils. This procedure permits more accurate estimates of total oil concentrations to be made by ensuring that fluorescing compounds observed in sample extracts are derived from petroleum. Similarities in spectral contour diagrams showed the presence of petroleum residues in beach sand from Bermuda, intertidal sand and sedimenting material from an inlet near an oil refinery in Nova Scotia, and in sand from Chedabucto Bay contaminated by a ship stranding in 1970. Total oil concentrations ranged from 10-3000 micrograms/gram wet sediment. Fluorescence patterns in many sample extracts did not resemble any standard oil, indicating the presence of material which did not originate from fresh petroleum.

*Analytical techniques, *Pollutant identification, *Oil wastes, Water pollution sources, Laboratory tests, Fluorescence, Spectroscopy

E055
ANALYZING ORGANICS IN DILUTE AQUEOUS SOLUTIONS,

Jolley, R. L., Katz, S., Mrochek, J. E., Pitt, W. W., Jr., and Rainey, W. T.

Oak Ridge National Laboratory,
Oak Ridge, Tennessee

Chemtech, p 312-318, May, 1975. 4 fig, 5 tab, 36 ref.

Discharge of organic compounds from domestic and industrial sewage treatment plants is of concern. To evaluate the possible consequences an integrated, multicomponent analytical procedure for the quantitative determination of organic constituents in the microgram/liter range in complex aqueous solutions has been developed. The method utilizes high resolution chromatography for separation followed by sequential use for identification of ion exchange chromatography, UV spectrophotometry, gas chromatography, and mass spectrometry. The automated high resolution liquid chromatographs were initially developed at oak Ridge National Laboratory. They have been successfully used for separating and detecting over 100 UV absorbing constituents from sewage effluents. In this case, 36 compounds were identified in the primary effluent sample tested; over 70 constituents were partially characterized. Nine compounds were identified in one sample of secondary effluent.

*Analytical techniques, *Organic compounds, *Domestic wastes, *Industrial wastes, *Pollutant identification, Chromatography, Ion exchange, Mass spectrometry, Gas chromatography

Ultraviolet spectrophotometry

E056
THE DETERMINATION OF BENZIDINE IN WASTEWATERS,

Jenkins, R. L., and Baird, R. B.

County Sanitation Districts of Los Angeles County,
Whittier, California, San Jose Creek Water Quality Laboratory

Bulletin of Environmental Contamination and Toxicology, Vol. 13, No. 4, p 436-442, April, 1975. 2 fig, 8 ref.

Benzidine (4,4'-diaminobiphenyl) has been included on the Occupational Safety and Health Administration's list of chemical carcinogens. Results and observations are reported on the development of analytical procedures for the determination of benzidine in the ppb range in waste waters such as raw sewage, secondary effluents, rivers, and industrial wastes. Waste water samples from the Los Angeles County area were routinely spiked with known amounts of benzidine/methanol standards. The treated samples were then subjected to a sample pretreatment procedure followed by colorimetric, GLC, or TLC analysis. Pretreatment involved adjustment to pH 11, extraction of the filtrate with diethyl ether, extraction of ether phase with 2N HCl, neutralization of acid phase with 10N NaOH, (at this stage colorimetric analysis could be performed), extraction of aqueous phase with diethyl ether, and concentration of ether phase, (at this stage the GLC and/or TLC analysis can be performed). The GLC analysis is sensitive and selective for benzidine and is preferred over the colorimetric or TLC analysis. The overall detection limit of the analysis is determined by the initial sample size and the volume of the final concentrate. The practical detection limit was in the range of 2-3 micrograms/liter. In unchlorinated waste waters, the experimental spike recoveries ranged between 70-95%. However, low recoveries were realized from chlorinated waste waters spiked with benzidine. The low recoveries are apparently due to the reaction of benzidine with hypochlorous acid to produce a chloramine type structure. The described analytical methods should be suitable for the determination of other carcinogenic anilines in waste waters.

*Waste water treatment, *Analytical techniques, *Pollutant identification

E057
STATISTICAL ANALYSIS OF OPERATIONAL PERFORMANCE OF SOME PACKAGE PLANTS,

Turvey, L. G. S.

Department of Water Affairs,
South Africa

Water Pollution Control, Vol. 74, No. 2, p 193, 1975. 2 tab.

A summary is given of the statistical analysis of nineteen package plants treating sewage flows of the range 9 to 455 cu m/day. The packages included biological filtration and activated sludge, mostly using aeration by diffused air. All samples of effluent analyzed were collected between July 1969 and November 1973 from the Transvaal area. Frequency curves for six pollution parameters were drawn. These were four hour permanganate value (PV), free and saline ammonia (NH3), chemical oxygen demand (COD), suspended solids (SS), pH value, and nitrate (NO3). Curves indicated percent conformances with government standards, and very poor performances were demonstrated. For combinations of parameters, PV and COD, conformance with standards was 37%, for PV and NH3, 33%, COD and NH3, 31%, PV, COD, and NH3, 30%, and PV, COD, NH3, and SS, 26%. Such unsatisfactory package plant performance has been attributed to: underdesign; unsatisfactory design; overloading; misuse such as poisoning; poor maintenance; poor supervision; or a combination of these factors. Although package plants provide convenient treatment for new township developments, army camps, and mining communities, their sub-standard performances must be improved if they are to continue in use.

*Waste water treatment, *Sewage treatment, Statistical analysis, Flow rate, Performance, Facilities, Water pollution, Biological treatment, Efficiencies, Suspended solids, Standards

Package plants, Performance evaluation

E058
FECAL CONTAMINATION--THE WATER ANALYST'S RESPONSIBILITY PART II,

Galvani, M. M.

St. Paul Water Department

Water and Sewage Works, Vol. 122, No. 1, 68-70, January, 1975. 1 fig, 42 ref.

A simple procedure for the analysis of fecal streptococci to determine their source has been developed. The new media used greatly simplifies the speciation of streptococcus faecalis var. liquefaciens. The procedure with the new media requires less scientific training for accurate results than the most probable number technique which is currently the commonly used method. The media can be easily checked to determine that the results are not from a mixed culture of streptococci. The method of determination does not require highly specialized equipment.

*Analytical techniques, *Laboratory tests, *Streptococcus, Sewage bacteria, Pollutant identification, Bioindicators, Water analysis

Fecal contamination

E059
MINITEST METHOD FOR MONITORING EFFLUENT QUALITY,

Elfving, E., Forsberg, A., and Forsberg, C.

Institute of Physiological Botany,
Uppsala, Sweden,
Algal Assay Laboratory

Journal of the Water Pollution Control Federation, Vol. 47, No. 4, p 720-726, April, 1975. 3 fig, 2 tab, 18 ref.

The long-run efficiency of six different treatment plants is described with the use of data obtained by continuous sampling from July 1973 to July 1974. Data include the effects of treatment disturbing factors, such as technical errors, incoming oil, or toxic compounds. Processes demonstrated are biological treatment with activated sludge and biological treatment in combination with five different types of phosphorus removal systems. Information was given on PO4-P, total P, NH4-N, NO2-N, NO3-N, AGP, and COD. The analysis of effluents from chemical treatment plants showed that both presimultaneous and postprecipitation gave, at maximum phosphorus reduction, weekly average values of about 0.2 mg/liter. The treatment efficiency was reduced by disturbances and by technical errors. The nitrification processes showed a comparatively high correlation with temperature. Some negative AGP values were found. Average COD values were between 30 and 40 mg/liter.

*Waste water treatment, *Facilities, *Data collections, Chemical oxygen demand, Water quality, Effluents, Nitrification, Biological treatment, Activated sludge, Analytical techniques

E060
VIROLOGICAL INVESTIGATIONS ON SLUDGES FROM SELECTED ONTARIO SEWAGE PLANTS,

Subrahmanyan, T. P.

Ontario Ministry of Health,
Ontario, Canada

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 95-109. 7 tab, 9 ref.

In cooperation with the Ontario Ministry of the Environment and the Toronto Works Department, the Virus Laboratory of the Ministry of Health conducted an investigation of viral isolation in sewage and sludge. Three hundred and fifty three specimens were collected between April and December 1973, from four sewage treatment plants. These specimens included sewage, raw sludge, digested sludge, and effluents. Viruses were isolated in 38.7% of the sewage, 13% of the raw sludge, and 0.9% of the digested sludge samples. During the colder months enteroviruses were rare or absent and reached their peak during August and September. The results of the 1973 study showed low viral hazards, this may be due to the situation of a year of low enterovirus prevalence. Additionally, the disposal system was not subject to stresses of a large scale facility. Further surveillance and routine monitoring are necessary for improving field use and extraction and assay method.

*Treatment facilities, *Viruses, *Waste water treatment, Sludge, Sewage, Effluents, Sewage treatment

Ontario Ministry of the Environment, Toronto Works Department

E061
SIMULTANEOUS DETERMINATION OF SEVEN TRACE METALS IN POTABLE WATER USING A VIDICON ATOMIC ABSORPTION SPECTROMETER,

Aldous, K. M., Mitchell, D. G., and Jackson, K. W.

New York State Department of Health,
Albany, New York,
Division of Laboratories and Research

Analytical Chemistry, Vol. 47, No. 7, p 1034-1037, June, 1975. 2 fig, 4 tab, 12 ref.

A technique for the analysis of trace metals in potable water and most waste waters has been developed. This vidicon atomic absorption spectrometer can be used to improve the efficiency of a moderately large water analysis laboratory. The multichannel spectrometer gives the simultaneous determination of seven important metals, Zn, Cd, Ni, Co, Fe, Mn, and Cu. Detection limits from 0.004 to 0.020 micrograms/ml have been obtained. A comparison between the vidicon spectrometer and a conventional single channel AA spectrometer for twenty potable water samples showed that in only three samples did the metal concentrations exceed the vidicon working limit; however, some concentrations were below vidicon detection limits. The system is not applicable to determining levels of lead or chromium. Its advantage is versatility; wavelengths are selected electronically so that it is simple to change the elements being selected. It was concluded that the system is satisfactory for routine monitoring of potable water.

*Pollutant identification, *Potable water, Heavy metals, Zinc, Cadmium, Nickel, Cobalt, Iron, Manganese, Copper, Spectrometers, Monitoring

*Trace metals, Vidicon multichannel spectrometer, Atomic absorption spectrometer

E062
INSTRUMENTAL INVESTIGATION OF BIOLOGICAL WASTE WATER TREATMENT (A szennyvisek biologiai tisztitasanak muszeres vizsgalata),

Fekete, S.

Kemiai Kozlemenyek, Vol. 42, p 277-283, 1974.

A method and an automatic instrument for the measurement of the respiration of bacteria as a parameter of biological waste water treatment are described, as well as measurement data concerning the biodegradation of phenol in waste water. The instrument is composed of a closed reactor vessel with carbon dioxide absorber for the activated sludge sample, and a communicating electrolytic cell with properly profiled electrolytes for oxygen generation as a function of the respiration intensity of the bacteria. The respiration intensity is measured as the current intensity of the electrolytic cell. Measurements in phenol-contaminated waste water revealed a prolonged adaptation period preceding the aerobic microbial oxidation of phenol. The adaptation time increases with the phenol concentration in the waste water, and with the phenol load of the activated sludge. The oxidation peak was demonstrated to be in proportion to the phenol concentration.

*Instrumentation, *Biological treatment, *Waste water treatment, Phenols, Oxidation, Measurement, Biodegradation, Analytical techniques

*Electrolytic cells

E063
AN AUTOMATED SPECTROPHOTOMETRIC SUSPENDED SOLIDS ANALYSIS FOR ACTIVATED SLUDGE,

Finger, R. E., and Strutynski, B. J.

Journal of the Water Pollution Control Federation, Vol. 47, No. 5, p 1043-1054, May, 1975. 11 fig, 4 tab, 15 ref.

The measurement of suspended solids (ss) concentration in biological waste treatment is used as a primary control for process adjustment. The ss measurement is necessary for calculation of cell residence time, organic loading, and sludge volume indexes. The determination of types of polysaccharides associated with activated sludge and their effects on the physical characteristics of sludge have been investigated by a simple colorimetric test. The purpose of this study was to consider the possibility of adapting this test to an automated procedure. A manual colorimetric procedure which takes two to three hours was first tested and it proved to effectively measure mixed liquor suspended solids and vss. The automated spectrophotometric ss test takes only fifteen minutes and was demonstrated to be practical for use on a continuous basis. The major problem with the technique is sampling, which may be improved by the installation of a homogenization system.

*Activated sludge, *Biological treatment, *Suspended solids, *Waste water treatment, Colorimetry, Automation, Sampling, Measurement, Analytical techniques

*Sludge volume index

E064
INTERLABORATORY STUDY OF METHODS FOR CHEMICAL ANALYSIS OF WATER,

Ekedahl, G., Junker, P., and Rondell, B.

National Swedish Environment Protection Board,
Drottningholm, Sweden,
Analytical Subdivision, Research Laboratory

Journal of the Water Pollution Control Federation, Vol. 47, No. 4, p 858-866, April, 1975. 5 fig, 1 tab, 12 ref.

A program for the intercalibration of methods for chemical analysis of nutrients was conducted in Sweden. Artificial samples with accurately calculated concentrations of known constituents were used for water analysis. Samples were preserved by acidification and distributed in sealed glass ampoules. These samples were then distributed to 76 laboratories where individual methods of analysis were used. Discussion and evaluation of results focused on methods and instrumentation; preservation, stability and pre-treatment of samples; and quality of work in different laboratories. For all parameters studied (such as phosphate phosphorus, total phosphorus, nitrate nitrogen) the Nordic Standard Methods yielded the best results. Most laboratories tested performed the analytical work with acceptable precision.

*Nutrients, *Pollutant identification, *Chemical analysis, Laboratory tests, Water analysis, Nitrogen, Phosphorus, Analytical techniques

*Sweden, Intercalibration, Interlaboratory studies

E065
CHEMICAL TESTS FOR PLANT AVAILABLE METALS IN SOILS,

Bates, T. E., and Haq, A.

Guelph University, Guelph, Canada,
Department of Land Resource Science

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 267-268. 3 ref.

The amount of nutrient in soil available to plants is not necessarily related to the total amount in the soil. A study is now in progress to determine a suitable extractant to measure plant available soils in Ontario. Emphasis has been placed on cadmium and copper which are important pollutants of sewage sludge. Thirty-five soils with varying amounts of copper and cadmium contamination have been collected in Ontario. Swiss Chard has been grown on the soils. An analysis will be made of the chard to determine the metal content and the soils extracted with EDTA, DTPA, ammonium acetate, and other chemicals. The metal extracted from the soils will be correlated with the metal uptake by the Swiss Chard. It is hoped that this experiment will determine an extractant that will give a satisfactory measure of plant available metals.

*Soils, *Nutrients, *Crops, Sewage sludge, Cadmium, Copper, Metals

Ontario, EDTA, DTPA, Ammonium acetate

E066
BIOCHEMICAL CHARACTERISTICS OF DIGESTED CHEMICAL SEWAGE SLUDGES,

Chawla, V. K., Stephenson, J. D., and Liu, D.

Environment Canada, Ottawa, Water Technology Centre,
Environmental Protection Service

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 63-94. 9 fig, 15 tab, 25 ref.

Phosphorus removal systems are being incorporated into many of the existing sewage treatment facilities in Ontario. The precipitating agents used are ferric chloride, lime or alum. The differences in chemical composition of these phosphorus rich chemical sludges have caused concern about the pollution potential of surface waters and groundwater, as well as of soil and plant systems. An extensive program was started in 1973 to study these biochemical characteristics. Samples were taken from four sewage treatment plants over a fifteen month period and analyzed for nutrients and heavy metals, microbial contents, pesticides, polychlorinated biphenyls (PCBs), lipids and petroleum hydrocarbons. The results of the study showed that each plant has to be considered individually due to variations in concentration of the materials studied. The amount of aerobic heterotropic bacteria was relatively constant. There were increases in nitrogen and phosphorus at all plants and pesticides were also present. There was a random variation of heavy metals and only one plant had a high concentration of petroleum hydrocarbons.

*Treatment facilities, *Sludge, *Nutrient removal, *Waste water treatment, Environmental effects, Phosphorus, Nitrogen, Heavy metals, Polychlorinated biphenyls, Pesticides, Organic compounds, Lipids, Aerobic bacteria, Lime

Phosphorus removal systems, Ontario, Biochemical characteristics, Precipitating agents, Petroleum hydrocarbons

E067
ADVANCES IN THE DETECTION OF WATER POLLUTANTS,

Barabas, S.

Canada Centre for Inland Waters,
Burlington, Ontario

Chemistry in Canada, Vol. 27, No. 6, p 26-29, June, 1975. 45 ref.

A review of analytical methodology of water for the Canada Centre for Inland Waters (CCIW) from December 1973 to November 1974 is given. All research of the CCIW is done as a response to needs of a federal regional laboratory, a research component of the CCIW, or an international organization in which Canada is actively collaborating. Progress in chromatography/mass spectrometry included the methodology for analyzing organochlorinated pesticides, dithiocarbamates, and 1,4-oxathiins as well as a number of industrial pollutants. Methods were gas chromatography, high pressure liquid chromatography, thin-layer chromatography, GC/MS, NMR, and infrared. The analysis of organic pollutants (phenols, formaldehyde), inorganic pollutants (chlorides, arsenic, antimony, selenium), and detergents (phosphate, citric acid) has also been developed. Methods were spectrophotometry, of the types UV, visible, molecular fluorescence, IR, and atomic absorption. Publications have been made under electroanalytical methodology, involving activities in the area of applying selective ion electrodes to multi-element analysis. Other related developments were in voltammetric applications. Biological analysis utilized coprostanol and cholesterol as indicators of excretal pollution in sewage and industrial treatment. Radiochemistry, electron microscopy, and remote sensing studies were also discussed.

*Analytical techniques, *Reviews, *Pollutant identification, Organic matter, Municipal wastes, Industrial wastes, Spectrophotometry, Gas chromatography, Mass spectroscopy, Remote sensing, Phenols

Canada Centre for Inland Waters, Coprostanol, Cholesterol, Voltammetry

E068
MEASURES OF BIODEGRADABILITY AND REFRACTORY ORGANICS IN WASTEWATERS: (ANALYSIS, INTERPRETATION, AND APPLICATION OF MEASUREMENT TECHNIQUES),

Hart, F. L.

Connecticut University,
Storrs, Connecticut

Dissertation Abstracts International B., Vol. 35, No. 11, p 5361, 1975.

The Ultimate Oxygen Demand (UOD) method for evaluating the total amount of oxidizable material bearing hydrogen, oxygen, carbon, and nitrogen, in waters was developed. A working parameter was formulated to approach the derived evaluation based on output responses of available analyzers. A modified Warburg Respirometer is used to determine the biodegradable portions of the total materials present, with a correction term for nitrification inconsistencies. The ratio of degradable material to the total oxidizable material is the Refractory Index (RI). The formula is RI = BOD(ultimate)/UOD. According to this index, easily degradable materials such as domestic raw sewage or glucose have RI values of 0.97 and 0.93, indicating 93-97% degradation, while industrial dye wastes or benzene have RI values of 0.56 and 0.23. Specific organic compounds were classified in terms of bio-persistence, using the RI values. Other uses of these values are suggested, such as the evaluation of acceptability of industrial waste discharge to municipal biological treatment facilities or the use as a preliminary treatment parameter.

*Measurement, *Oxidation, *Hydrogen, Carbon, Nitrification, Biodegradation, Analytical techniques, Municipal wastes, Industrial wastes

Refractory Index (RI), Ultimate Oxygen Demand (UOD)

E069
ANALYSIS OF HEAVY METALS IN SEWAGE SLUDGE AND LIQUIDS ASSOCIATED WITH SLUDGES,

Van Loon, J. C.

Toronto University, Canada, Departments of Geology, Chemistry and the Institute of Environmental Studies.

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 234-248. 9 tab, 10 ref.

The equipment and techniques for the analysis of heavy metals in sewage sludge and liquids associated with sludges are presented. It is questionable whether a grab sludge sample can be considered as representative of the sludge in a digester tank. Data presented suggest that the majority of the sludge water metal is bound tightly and therefore is not readily detectable using extractable metal procedures. Nickel, copper, and cadmium appear to be little affected by filter porosity size. Lead was found in the solids residue trapped by a 60 micron porosity filter. The metal contents of sludges ranged from: 2-147 ppm Cd; 16-16000 ppm Cr; 85-4000 ppm Pb; 7-1500 ppm Ni; 162-3000 ppm Cu; 1-24 ppm Hg; 60-500 ppm Mn; 4-60 ppm Ag; 610-19000 ppm Zn; 0.33-7.4 ppm Fe; and, 0.10-3.9 ppm Al. The analytical techniques used allowed the detection of cadmium and zinc above 0.2 ppb and the detection of iron, lead, copper and nickel above 1.0 ppb. The high metal levels detected in sewage treatment plant products in this study demonstrate a need for research into the fate of these metals after reacting with terrestrial and aquatic environments.

*Analytical techniques, *Heavy metals, *Sewage sludge, *Pollutant identification, Iron, Lead, Copper, Cadmium, Nickel, Zinc

E070
POLLUTION DETECTION AND RIVER QUALITY MANAGEMENT,

Woodward, G. M.

Lothians River Purification Board,
Great Britain.

Water Treatment and Examination, Vol. 24, Pt. 1, p 3-22, 1975. 2 tab, 8 ref.

The management of river water quality as the responsibility of the River Purification Boards in Scotland and of the Regional Water Authorities in England and Wales is discussed. Speed of action is important in dealing with short term surface water pollution which has occurred either accidently or deliberately. Short term pollution in the form of fishkills or a visible pollutant should be reported so that case warnings can be issued to downstream locations with remedial action to be taken. Instrument monitoring, chemical sampling, and biological examination of the river bed fauna are methods by which less obvious pollutants can be detected. Long-term surface water pollution can be detected by monitoring over several years to show the improvement or deterioration of water quality in a given river. Other detection methods are biological assays to study fish populations and water sampling for odor by measuring chemical compounds which are not instrument-detectable. Some remedial actions to improve long-term river quality are: increasing effluent dilution; use of river purification lakes; and river aeration. Detection of pollution in estuaries is carried out by survey vessels equipped for scientific studies. Each estuary must be considered individually regarding fresh water flow, tidal conditions, and wind. Estuarine pollution can present public health hazards by the contamination of edible fish in the food chain and by the pollution of beaches. Detection and measurement of aquifer and groundwater pollution is difficult, as it usually occurs gradually; chemical analysis is the common method of detecting groundwater pollution.

*Rivers, *Water quality, *Management, Water pollution, Surface waters, Fishkill, Monitoring, Sampling, Fish populations, Odor, Instrumentation, Estuaries

E071
APPLICATION OF THE METHYLTHYMOL BLUE SULFATE METHOD TO WATER AND WASTEWATER ANALYSIS,

Adamski, J. M., and Villard, S. P.

Ontario Ministry of the Environment,
Rexdale, Ontario, Canada.

Analytical Chemistry, Vol. 47, No. 7, p 1191-1194, June, 1975. 3 fig, 2 tab, 6 ref.

The present standard sulfate method for water and waste water analysis is the gravimetric method. However, this method is tedious and time consuming. A faster Methylthymol Blue technique has tested to be satisfactory. A comparative study of the two methods is presented. Both methods were evaluated by finding the differences between duplicate analyses for samples of "waters" (clear samples from water supplies), "rivers" (natural surface waters), and "sewage" (raw inputs from domestic treatment plants as well as final effluents from both municipal and industrial sources) containing sulfate in a 0-50 mg/liter and a 0-200 mg/liter range. For precision, sensitivity, and number of interferences, the automated Methylthymol Blue method was analytically superior to the gravimetric method. It was also economically advantageous, having lower costs per analysis, a greater analysis speed, and smaller bench space requirements for performing the analysis.

*Analytical techniques, *Sulfates, *Water analysis, Gravimetric analysis, Economics

Methylthymol blue method, Precision analysis

E072
PHOSPHORUS DISTRIBUTION IN BLACKSTRAP LAKE SEDIMENTS,

Hwang, C. P., Huang, P. M., and Lackie, T. H.

Saskatchewan University,
Saskatoon, Canada,
Departments of Civil Engineering and Soil Science.

Journal Water Pollution Control Federation, Vol. 47, No. 5, p 1081-1085, May, 1975. 4 fig, 1 tab, 14 ref.

Lakes are subject to increased pollution due to industrial and domestic waste discharge. Phosphorus has been implicated as the major growth-promoting nutrient, which affects the characteristics of sediments and therefore affects the overlying water quality through biological, mechanical, and chemical exchanges. An investigation was made of Blackstrap Lake, the largest reservoir in the Saskatoon South East Water Supply System in Saskatchewan, Canada in order to determine the distribution of total, organic, and inorganic phosphorus in various sized fractions of the lake sediments. It was found that there is little difference in total phosphorus among the 5 to 20, 20 to 50, and greater than 50-micron sized fractions; there was a marked increase in total P in the under 5-micron sized fractions, however. Distributions are given in tabular form but no conclusions were drawn about the patterns of the data. It was suggested that further study be conducted to ascertain what factors affect the interchange of phosphorus between the sediment interstitial water and the overlying water column, and the role of phosphate in lake eutrophication.

*Lakes, *Phosphorus, *Analytical techniques, Eutrophication, Sediment distribution, Pollution abatement, Water quality control, Canada

E073
WATER CHARACTERISTICS,

Olofson, J. A., and Ghosh, M. M.

Maine University, Orono.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1161-1169, June, 1975. 73 ref.

A review of the literature on analytical techniques for determination of water characteristics is presented. Attention has been given to the finding of heavy metals and associated ligands in natural waters. Analytical procedures such as voltammetry and pulse polarography are described. Naturally occurring Fe fractions in seawater have been examined. Calculations have also been made to assess the degree to which Hg(II), Cd(II), Zn(II), and Pb(II) form complexes with hydroxyl and chloride ions in natural systems. Transport of heavy metals by water and bottom sediments has been investigated. Other methods of water analysis were atomic absorption spectrophotometry for arsenic determination, uv and visible spectrophotometric methods for trace metal speciation, and liquid-liquid extraction of organic compounds. Further studies included the retention of phosphate and sulfate by muscovite, thermal aspects of aquatic chemistry as related to effects upon physical-chemical parameters, and a phosphorus model related to lake eutrophication. A new index of water quality has been proposed, based on temperature, nutrients, ss, turbidity, coliform bacteria, DO, color, odor, and toxicity; it has been applied to surface waters in Tennessee. Reviews have also been made of various aspects of natural water chemistry with regard to bioassay evaluation of water quality.

*Reviews, *Water analysis, Heavy metals, Analytical techniques, Eutrophication, Water quality, Water chemistry, Suspended solids, Turbidity, Odor toxicity

Ligands, Voltammetry, Spectrophotometry

E074
A REVIEW AND EVALUATION OF MULTIOBJECTIVE PROGRAMING TECHNIQUES,

Cohon, J. L., and Marks, D. H.

Johns Hopkins University, Baltimore, Maryland, Department of Geography and Environmental Engineering.

Water Resources Research, Vol. 11, No. 2, p 208-220, April, 1975. 5 fig, 5 tab, 48 ref.

Three criteria were established for the evaluation of the utility of multiobjective programmming techniques for water resources planning. These are computational efficiency, explicitness of trade offs among objectives, and the amount of information generated for decision making. Generating techniques were among the first multiobjective solution procedures developed, their purpose being to identify the set of noninferior solutions X*, as well as the noninferior set Z(X*). Thus they provide all of the information one can extract from a multiobjective model, and include weighting and constraint methods, and vector optimization. Noniterative methods rely on the articulation of preferences prior to the solution of the multiobjective problem. Goal programming is a noniterative method which is based on the minimization of weighted absolute deviations from targets for each objective. It allows deviations to be weighted according to priorities in each objective, and is computationally efficient with respect to generating methods. Utility functions and optimal weights are components of another noniterative method. Utility functions lead to a best-compromise solution for a particular problem. The Electre method is also noniterative, and it attempts to structure a partial ordering of alternatives which is stronger than the incomplete ordering implied by noninferibility, and which still allows some incompatibility to remain. The surrogate worth trade off method is based on choice of optimal weights being made with the knowledge that trade offs are a function of the levels of the objectives. Techniques which rely on progressive articulation of preferences are also discussed, and the various methods are evaluated and contrasted.

*Water resources, *Planning, Model studies, Decision making, Mathematical studies

E075
MEASUREMENT OF SMALL DISCHARGES THROUGH V-NOTCH WEIRS,

Leupold, N., Jr., and Blais, R. S.

Leupold and Stevens, Incorporated, Beaverton, Oregon.

Water and Sewage Works, Reference Number, p 148-150, April 30, 1975. 1 fig, 4 tab.

V-notch weirs may be used for the measurement of small streams, irrigation canals, sewers and other open channels to determine discharge. Temporary weirs may be constructed of plywood, wood 2 x 4's, plastic sheeting, sandbags or gravel, while more permanent installations may use concrete. The principle of a weir is that a barrier or bulkhead is provided across a stream so that water will over flow the barrier through a V-notch cut in the center. A staff gage is placed on the side of the weir chamber, some distance upstream from the crest of the weir, with the zero on the same elevation as the weir crest. Discharge rate is determined by reading the staff gage to compare head and flow and by consulting a chart. Units are given as cubic feet per second or million gallons per day. The weir bulkhead may be made from a thin piece of aluminum or stainless steel cut to the approximate shape of the channel cross section. A notch is cut in the top edge, with the weir set into the channel. Four sizes of V-notches--90 degrees, 60 degrees, 45 degrees, and 22 1/2 degrees--would be selected according to the maximum flow and allowable depth over the weir. For very small flows, a 22 1/2 degree V-notch is used, while for longer flows, a 90 degree V-notch is appropriate. Usually a chart recorder will be installed in connection with the V-notch weir in order to obtain a continuous record. A stilling well may be utilized to confine the float, and a platform to mount the instrument can be placed on the upstream side of the weir, to one side of the notch.

*Analytical techniques, *Flow measurement, *Discharge (water), *Weirs, Instrumentation

V-notch weirs

E076
THE IMPACT OF CHEMICAL POLLUTION ON WATER UTILIZATION
(CHEMISCHE GEWAESSERVERUNREINIGUND UND WASSERNUTZUNG),

Sontheimer, H.

Schweizerische Zeitschrift fuer Hydrologie, Vol. 37, No. 1, p 118-134, June, 1975.
9 fig, 3 tab, 12 ref.

Potable water from natural reservoirs is threatened by pollution by synthetic chemicals. The Rhine river is described; its lower reach is enriched with refractory organic compounds which are the result of self-purification of industrial pollution from the upper part of the river. Changes in water composition are detected by various analytical methods, such as the quantitative determination of individual substances or groups of substances. In addition, methods have been applied which indicate the organic content by overall parameters such DOC, COD, or UV-extinction. Studies in the winter of 1971-1972 indicated that refractory compounds in industrial waste water should be eliminated by physico-chemical techniques in addition to the conventional biological treatment before discharge to the river.

*Water quality control, *Analytical techniques, *Water pollution sources, *Industrial wastes, *Organic compounds, Chemical oxygen demand, Chemical analysis, Biological treatment, Waste discharge

*Rhine River, Physico-chemical treatment, Refractory compounds

E077
INDIVIDUAL REMOVALS OF ANIONIC SURFACTANTS IN MUNICIPAL SEWAGE TREATMENT PLANTS,

Sekiguchi, H., Miura, K., Yagi, R., and Oba, K.

Lion Fat and Oil Company, Limited, Hirai, Edogawa-ku, Tokyo, Japan.

Abura Kagaku, Vol. 24, No. 5, p 311-313, 1975. 8 ref.

Removals of three anionic surfactants from municipal sewage treatment plants were analyzed and compared for a one year period. Linear alkylbenzene sulfonate (LAS), branched alkylbenzene sulfonate (ABS), and alpha olefin sulfonate (AOS) were examined by infrared spectroscopy. Samples of these substances were taken from raw municipal sewage and effluent from sewage treatment plants. Individual removals of these anionic sulfate-type surfactants were 85%, 35%, and 100% for LAS, ABS, and AOS, respectively. For these same surfactants, BOD and total organic carbon (TOC) removals were 90 and 68%, respectively.

*Waste water treatment, *Surfactants, Analytical techniques, Linear alkylate sulfonates, Water pollution sources, Municipal wastes, Effluents, Biochemical oxygen demand

Branched alkylbenzene sulfonate, Alpha olefin sulfonate, TOC

E078
INORGANICS,

Minear, R. A., Henderson, J. S., McEntyre, C. L., and Rose, R. R.

Tennessee University, Knoxville, Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1118-1162, June, 1975. 429 ref.

An in-depth review of current literature on the nature and analysis of chemical species, with inorganics in particular, is presented. Water samples from various types of oceans, lakes, and rivers as well as effluent discharges were analyzed. Sample concentrations and separation techniques are described. Much literature has been reported on the application of instrumental techniques including atomic absorption spectrophotometry, flameless atomic absorption, atomic fluorescence, emission spectroscopy, gas and liquid chromatography, electrochemical analysis, neutron activation analysis, and other radiochemical techniques. Tables are given for a cross reference to the specific analytical methods and individual constituents. Colorimetric and titrimetric methods were conducted for halogens, ozone, sulfur compounds, cyanide, boron, silicon, phosphorus, nitrogen, iron, manganese, and aluminum, as well as for various transition metals.

*Reviews, *Water analysis, *Chemical analysis, *Inorganic compounds, Lakes, Rivers, Oceans, Radiochemical analysis, Neutron activation analysis, Spectrophotometry, Colorimetry, Sampling

E079
THE RELATIONSHIP BETWEEN PROCESS CONFIGURATION AND PROCESS PERFORMANCE,

Schroeder, E. D.

University College of Swansea,
Wales,
Department of Chemical Engineering.

Journal Water Pollution Control Federation, Vol 47, No. 5, p 1005-1011, May, 1975. 4 fig, 1 tab, 7 ref.

An analytical study was conducted to compare the performance of the ideal continuous flow, stirred tank reactor (CFSTR) with the ideal plug flow activated sludge process. Both the CFSTR and the nominal flow process may be designed using the same criteria. This is unusual because plug flow processes are normally considered more efficient than the CFSTR because of higher average reaction rate. It has been suggested that either fundamental biological differences exist between the two processes or that backmixing is so great in conventionally designed processes, that they become similar to CFSTR's. Neither explanation has been accepted as complete, and this analysis was carried out to demonstrate that in real systems, required operating constraints force the result that both ideal plug flow and ideal CFSTR processes effectively produce the same effluent quality. Mass balance equations for both plug flow and CFSTR processes were outlined. Rate coefficient values and yield were also described. Performances of the two processes were compared by determining effluent concentration values over a range of cell resident times. The most significant finding was that, in the cell residence time region necessary for good cell flocculation with respect to cell separation, both systems gave acceptable effluents. The critical factor in activated sludge process design must therefore be to accomplish organic removal by producing well flocculated sludge.

*Activated sludge, *Analytical techniques, Performance, Flocculation, Effluents, Waste water treatment

Plug flow process, Continuous flow, stirred tank reactor (CFSTR), Effluent quality

E080
CELLULOSE DEGRADATION IN WASTEWATER TREATMENT,

Edberg, N., and Hofstein, B. V.

Uppsala University,
Sweden,
Institute of Limnology.

Journal Water Pollution Control Federation, Vol. 47, No. 5, May, 1975. 12 fig, 1 tab, 19 ref.

Almost half of the organic matter in municipal waste water is made up of cellulose and hemicellulose fibers and it has been postulated that the rate of cellulose degradation may be a limiting factor in waste water sludge fermentation. While cellulolytic bacteria are found in anaerobic digestors and in the aerobic sections of some activated sludge treatment plants, little study has been done on their activity. Previous work has shown that the rate of degradation of different fibers may be estimated by enclosing fiber samples in nylon bags of a fabric resistant to microbial degradation, and by measuring the weight loss occurring when the bags are kept immersed in water, where bacteria grow on the cellulose and form gaseous and water-soluble metabolic products, with a resultant loss in bag weights. In this investigation, experiments were conducted using the nylon bag method to study degradation of sulfite pulp, including egression effects and degradation in suspensions, as well as to compare degradation of different types of fibers and cellulose degradation in different stages of waste water treatment. Because bacterial cellulose degradation is a slow process, a retention time of several weeks is needed for fibers to be degraded appreciably. These long retention times normally are found only in anaerobic treatment processes. It was concluded that the nylon bag method is a useful method to study the fate of cellulose-containing fibers discharged with waste water into different environments. Depending upon the degradation rate of such fibers, increased oxygen consumption may result. Thus, it is important to quantitatively measure the degradation process to determine ecological effects.

*Municipal wastes, *Waste water treatment, *Environmental effects, *Cellulose

E081
SCALING LAWS FOR COAGULATION AND SEDIMENTATION,

Delichatsios, M. A., and Probstein, R. F.

Massachusetts Institute of Technology,
Cambridge, Massachusetts,
Department of Mechanical Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 5, p 941-949, May, 1975.
2 fig, 19 ref.

The fluid dynamic aspects of coagulation, breakup, and sedimentation, three processes fundamental to most waste water treatment systems, are examined. In this case, the details of the interactions among the particles or between the particles in the continuous phase are presented for an idealized isotropic turbulent flow. The results, however, may be applied to dispersed systems in turbulent pipe flows. A rational design of a waste water treatment or water purification system may be achieved by analysis of the physico-chemical properties of a dispersed system from in situ measurements. In this proposed system, coagulation of solid particles takes place before the waste waters are discharged into a sedimentation tank. A chemical and mechanical system was suggested for a small community, such as a ship. Scaling laws for coagulation, breakup, settling, and regimes are presented in mathematical terminology. This case study showed that an understanding of the fluid mechanical aspects, combined with physico-chemical properties of the dispersed phase, may be used to design a rational and efficient treatment system. Advantages of coagulation in a turbulent pipe flow are discussed. This pipe flow coagulation system for suspended solids removal, combined with carbon reactors for removing residual organic wastes, is recommended to form an integrated physico-chemical waste water treatment scheme.

*Waste water treatment, *Water purification, Fluid mechanics, Sedimentation, Coagulation, Design, Scaling, Ships, Turbulent flow, Treatment facilities

Physico-chemical properties, Shipboard wastes, Turbulent pipe flow

E082
ADSORPTION OF POLIOVIRUS ONTO ACTIVATED CARBON IN WASTEWATER,

Gerba, C. P., Sobsey, M. D., Wallis, C., and Melnick, J. L.

Baylor College of Medicine,
Houston, Texas,
Department of Virology and Epidemiology.

Environmental Science and Technology, Vol. 9, No. 8, p 727-731, August, 1975.
8 fig, 4 tab, 19 ref.

While it is known that activated carbon adsorbs viruses from treated sewage, an investigation was made to determine how to optimize this process. Poliovirus removal from sewage effluents was improved significantly (by about 25 times) by lowering the pH from near neutral (8) to 3.5-4.5 or by reducing the concentrations of soluble organic matter by lime coagulation. However, further study is required to determine if carbon column operation under acidic conditions would be economically feasible and practical. Batch studies were made and showed that Freundlich isotherms could be used to describe virus adsorption to activated carbon. Column studies indicated that viral removal efficiency was dependent on column length and hydraulic loading, with greater removals at lower loading.

*Waste water treatment, *Activated carbon, *Adsorption, Hydrogen ion concentration, Sewage treatment, Viruses, Acidity

Lime coagulation, Batch studies, Poliovirus, Viral removal, Freundlich isotherms

E083
ALKALINITY CALCULATIONS IN WATER,

Zonker, A.

Kiriat-Yam "G", Haifa, Israel.

Water and Sewage Works, Reference Number, p R162-R163, April 30, 1975. Revised by H. G. Swope. 1 fig, 1 tab, 1 ref.

The simple, classical method of alkalinity determination in water is based on double titration with acid. Phenolphthalein and methyl orange are used to indicate the titration end points. A well known table of values may be obtained by using 100 ml of water and 0.02N acid as a titrant, and determining P as the quantity of acid consumed from the beginning to the phenolphthalein end point, and T as the quantity of acid consumed from the beginning to the methyl orange end point. A nomograph is presented which includes these possibilities. By connecting the known values of P and T, one can determine the concentration of hydroxides, carbonates, and bicarbonates. Several examples are given. Since the nomograph is based on a 100 ml sample and 0.0200N acid, care must be taken to insure that the test acid has the exact normality and corrections must be made for samples of less than or more than 100 ml.

*Analytical techniques, *Water analysis, *Alkalinity, Chemical analysis, Bicarbonates, Carbonates

Hydroxides, Titration, Nomagraphs

E084
PREDICTION OF ASSIMILATION CAPACITY IN RECEIVING STREAMS,
PART I,

Gaudy, A. F., Jr.

Oklahoma State University, Stillwater,
Department of Civil Engineering.

Water and Sewage Works, Vol. 122, No. 5, p 62-65, May, 1975. 3 fig.

The practical method described for predicting the dissolved oxygen profile has been used for studying the assimilation capacity of a portion of the Red River in Oklahoma. This method overcomes some of the problems associated with the use of the Streeter-Phelps sag equation which have led to a lack of accurate prediction. The Streeter and Phelps concept states that the dissolved oxygen profile is the result of deoxygenation due to introduction of organic pollutants, and reoxygenation due to mass transfer of oxygen from the atmosphere. The integrated form of a mathematical expression of this concept is known as the "sag equation". A better expression for the sag equation would be to describe it as a function of reaeration minus oxygen uptake. A rationale for this description is presented. The only BOD curve that can be expected to hold true for the receiving stream situation is one obtained by using the same dilution as that expected in the receiving stream. This is not always possible using the normal closed bottle BOD dilution technique. A stirred open jar reactor system is proposed as an improved practical method for estimating BOD curves rather than the standard closed bottle technique. The first step is to add the effluent and the receiving stream water in the desired proportion and aerate the system to bring the DO level close to the saturation concentration. A portion of acclimated seed is then added to the river water. After initiating the experiment, the dissolved oxygen profile is determined electrometrically.

*Dissolved oxygen, Biochemical oxygen demand, Oxygen sag, Oxygenation, Waste water disposal, Analytical techniques, Rivers, Measurement

E085
PREDICTION OF ASSIMILATION CAPACITY IN RECEIVING STREAMS, PART II,

Gaudy, A. F., Jr.

Oklahoma State University,
Stillwater,
Department of Civil Engineering.

Water and Sewage Works, Vol. 122, No. 6, p 78-79, June, 1975. 2 tab, 17 ref.

A procedure for predicting the dissolved oxygen profile from the calculated oxygen uptake curve in streams receiving effluent discharges is outlined. The procedure has been used to determine the assimilation capacity of part of the Red River in Oklahoma. The dissolved oxygen saturation value and the reaeration constant K2 are calculated; deficit is computed, multiplied by the K2 value, and recorded. The time interval and the average values during the time interval are taken. From this, the change in dissolved oxygen (DO) concentration may be computed as the oxygen uptake during a particular interval. By repeated calculations, a representative average accumulated oxygen uptake curve (BOD curve) may be made for the effluent-river water mixture. From this curve, the dissolved oxygen profile may be computed. In this case, oxygen uptake for BOD values was read off at even hour intervals. After accounting for the amount of deficit from saturation, the amount of oxygen added during each time interval was obtained by multiplying the reaeration constant (K2) by the deficit value and delta time. Calculations are easily computer programmed. In many receiving stream situations, K2 does not remain constant and must be adjusted for each successive downstream reach. For open jar reactor techniques, it is suggested that preliminary and training runs be used. While this method is still under investigation, it has been successfully used to make an engineering prediction of the impact of an effluent on the DO of a resource.

*Dissolved oxygen, *Streams, *Waste discharge, Oxygen demand, Biochemical oxygen demand, Analytical techniques

Assimilation capacity, Effluent discharges, Oxygen uptake curve

E086
PREPARING AN INFILTRATION/INFLOW ANALYSIS,

Podolick, P. A.

Gilbert Associates, Incorporated,
Reading, Pennsylvania.

Water and Sewage Works, Reference Number, p 31-32, 34, April 30, 1975. 1 tab.

In order to receive Federal funding for upgrading a secondary treatment plant to provide tertiary treatment, it was necessary for an engineering and consulting firm in Pennsylvania to perform an analysis to demonstrate to the EPA that the sewer system discharging into the treatment works was not subject to excessive infiltration/inflow (i/i). First, a review for the past several years of total daily waste water flow was done to compute average daily dry and wet weather flows. Geological and geographic factors were considered, which might influence quantities of waste water flow. Engineering reports and contract documents for the original construction of the sewage facility were also reviewed. Field measurements of drainage from potential infiltration/inflow sources were made between midnight and 5:00 a.m. for key manholes, in order to insure that the measurements were due to i/i and not to domestic sewage. V-notch weirs were used for measurements directly into the sewer pipes. Cost of eliminating infiltration/inflow were determined by sewer system evaluation and a calculation of sewer rehabilitation costs. A cost effective analysis was performed, and it was found that the annual cost of eliminating all the i/i possible and treating the rest was $11,355, while the annual cost of treating i/i for the design life of the facility would be $33,226. Thus, Federal law stated that "possible" excessive infiltration/inflow existed and that further evaluation was required.

*Infiltration, *Inflow, *Sewerage, *Waste water treatment, Construction, Analytical techniques, Cost analysis, Repairs, Weirs, Sewers

*Infiltration/inflow, Sewer rehabilitation

E087
ORGANIC RESIDUE IN RECYCLED EFFLUENT, PART II,

Adams, V. D., Middlebrooks, E. J., and Nance, P. D.

Utah State University, Logan.

Water and Sewage Works, Vol. 122, No. 7, p 98-99, July, 1975.

There has been much concern about the hazard of consuming recycled water because of the chlorinated organic compounds which may be found. An investigation was conducted to study liquids resulting from the use of chlorine as a disinfectant. Although the present study involved reuse of waste water treatment effluents for flushing purposes, and not for human consumption, data should be applicable to other chlorination uses. Material was isolated from recycled effluents by extraction techniques and was found to be a complex mixture, consisting mainly of saturated chlorinated fatty acids. Lipids were present in feces in a quantity significant enough to result in such saturated chlorinated fatty acids, due to a conversion process by free radical chlorination. The rate of accumulation of these chlorinated fatty acids is directly related to the concentrations of lipids added to the system and to the free chlorine maintained in the recycled effluent. Therefore, it is useful to determine the level of organic carbon acceptable in the recycling system so that the bactericidal and virucidal properties of chlorine are not impeded. This will establish a minimum level for acceptable free chlorine residual for the recycled effluent.

*Organic compounds, *Chlorination, *Analytical techniques, Water reuse, Effluents, Recycling

Chlorine residual

E088
FATE OF TRACE METALS IN LOS ANGELES COUNTY WASTEWATER DISCHARGE,

Morel, F. M. M., Westall, J. C., O'Melia, C. R., and Morgan, J. J.

Massachusetts Institute of Technology,
Cambridge, Massachusetts,
Department of Civil Engineering.

Environmental Science and Technology, Vol. 9, No. 8, p 756-761, August, 1975.
4 fig, 2 tab, 14 ref.

Possible long range and short range effects of disposal of sewage containing trace metals into the coastal environment were investigated in Los Angeles County, California. Concentrations of various metals in sediments adjacent to a major outfall system were analyzed for amounts of Zn, Hg, Ag, Cu, Cd, and Pb (found in very insoluble sulfide), Cr and Fe (found in oxide forms), and Ni, Co, and Mn (which are relatively insoluble). The Los Angeles County area sewage is unusually reduced and metal-rich in nature, and probably atypical of most sewage discharged from marine outfalls. However, studies of oxidation and dilution of the sewage by seawater indicated that most metals were solubilized upon ocean disposal and were well dispersed. The question of whether nearby sediments are a mixture of naturally occurring sediments and sewage particulate was left unanswered. It was estimated that 0.5% to 1.0% of the sewage organics are deposited. Further research on the interactions of suspended particulate matter for a better understanding of the fate of metal pollutants in waste water is recommended.

*Heavy metals, *Environmental effects, *Sewage disposal, California, Sediments, Zinc, Mercury, Gold, Copper, Cadmium, Lead, Chromium, Iron, Nickel, Cobalt, Manganese, Outfall sewers, Waste disposal, Pollutant identification

Trace metals, Ocean disposal

E089
AN ASPECT OF THE SOLIDS RETENTION TIME CONTROL IN THE ACTIVATED SLUDGE PROCESS (Kassei oden purosesu ni okeru yojo oden no haishutsu),

Ota, R.

Gesuido Kyokaishi, Vol. 12, No. 133, p 52-57, June, 1975. 4 fig, 2 ref.

The solids retention time (SRT) and total sludge quantity in a precipitation pool are considered mathematically based on the Walker's SRT Controlling Equation. The effects on water quality of periodic and nonperiodic sludge removals from the precipitation pool which may be governed by SRT control are considered as they relate to the sewage treatment plant at Fukashiba, in the Ibaragi Prefecture of Japan. Since the spread of sludge particle movement is faster than that of water, the sludge precipitation process is dependent upon the capacities of the aeration and precipitation pools for calculation of the volume of activated sludge. The concept of SRT control for water quality is not applicable to controlling total sludge quantity, and the SRT values must be determined empirically for each individual plant. The SRT value at the Fukashiba plant was estimated to be about 65 days, which was larger than the value estimated by Walker of 5 to 10 days for municipal waste water. However, the Fukashiba plant was treating large amounts of waste water from the petrochemical industry. Periodic or continuous removal of excess sludge from the precipitation pool gave a stable quality to the treated water, with the standard deviation of COD as 4 mg/liter, while non-periodic removal gave a deviation of between 12 and 29 mg/liter.

*Activated sludge, *Mathematical studies, *Waste water treatment, Sludge treatment, Water quality control, Treatment facilities, Precipitation (chemical)

*Japan, *Solids retention time (SRT), *Solids removal

E090
MODIFICATION OF THE IODIMETRIC TITRATION METHOD FOR THE DETERMINATION OF BROMIDE AND ITS APPLICATION TO MIXED DOMESTIC-INDUSTRIAL WASTE EFFLUENTS,

Bender, D. F.

Environmental Protection Agency, Cincinnati, Ohio,
National Environmental Research Center, Methods Development and Quality Assurance Research Laboratory.

The Analyst, Vol. 100, No. 1191, p 400-404, June, 1975. 2 tab, 5 ref.

A modification of the ASTM Method D1246-C for detecting bromides in water is presented. The ASTM method is capable only of determining levels of bromide above 50 mg/liter because it involves observing slight changes in the yellow color of bromine. As these color changes cannot be detected in a colored sample, such as sewage and industrial waste waters, the modification described uses standard concentrations of the reagents in order to ensure that there is a sufficient amount of reagent, and yet not too great an excess which would produce a high blank. The modification lowers the upper limit of the range. The range of 2 to 20 mg/liter was determined by calculating the amounts of reagents that were necessary to determine a maximum of 25 mg/liter of bromide; then, an excess was added to compensate for reagent consumed by interferents. The modified method is applicable to highly colored samples in the range of 2 to 20 mg/liter of bromide when the iodide concentration is also in that range or lower. Samples that are more concentrated in either component must be diluted. Spiked samples should be run with each sample type to test for interferents.

*Analytical techniques, *Pollutant identification, *Bromides, *Iodides, Waste water treatment, Sewage treatment, Water analysis

ASTM Method D1246-C, Titration

E091
EPA CREATES NEW SEWER AND PLANT INDEXES,

Engineering News Record, Vol. 194, No. 25, p 73-74, June 19, 1975. 2 tab.

A set of three municipal treatment plant and sewer project construction cost indexes is being published by the Environmental Protection Agency. These have been developed by the ICARUS Corporation and replace previous EPA indexes. The three basic indexes are large city advanced treatment (LCAT), small city conventional treatment (SCCT), and complete urban sewer system (CUSS). The indexes were computed on the basis of current technology, labor productivity, and vendor profits. Model plants which served as a basis for each index were constructed from a data base which is continually updated as innovations cause changes in the costs of various factors. In the case of the LCAT index, component configurations for a model 50 mgd and a model 5 mgd facility were selected, including bar screen, grit chamber, primary clarification, activated sludge, lime clarification, multi-media gravity filtration, chlorination, gravity thickening, vacuum filtration, and multiple hearth incineration. A computer program was then used to design a model plant, identifying major cost elements. For LCAT, these were: equipment (17.2% of total cost); civil material and labor (35.4%); piping material and labor (10.3%); electrical material and labor (2.7%); and construction overhead (22.5%). Index equations were formulated by finding those materials and/or wage rates that would typify the movement of a particular cost component. A profit adjustment factor and a productivity factor were included in this calculation. For creating the SSCT and the CUSS indexes, similar procedures were applied.

*Construction costs, *Sewerage, *Waste water treatment, *Treatment facilities, Municipal wastes, Data processing, Computers, Model studies

Cost indexes, Environmental Protection Agency

E092
TRACE ELEMENTS IN CORN GROWN ON LONG-TERM SLUDGE DISPOSAL SITE,

Kirkham, M. B.

Advanced Waste Treatment Research Laboratory,
Environmental Protection Agency,
Cincinnati, Ohio.

Environmental Science and Technology, Vol. 9, No. 8, p 765-768, August, 1975.
4 tab, 18 ref.

Sludge has been applied to land both for disposal purposes and for use as a soil conditioner and fertilizer, and concern has been expressed as to long-term concentrations of trace elements present in the dewatered sewage. An investigation was made as to whether plants grown on these soils might accumulate trace metals in amounts toxic to man or animals eating the crop. Corn plants (Zea mays L.) grown on soil treated with municipal sludge for 35 years in Dayton, Ohio, at a rate of 28 metric tons of sludge/ha/yr; plants from a plot that had been saturated with supernatant from sludge-holding lagoons from 1968 to 1971; and plants grown in a control plot that had never received sludge, were compared for trace element concentration. Their grains were analyzed for Al, Cd, Cu, Fe, Mn, Ni, Pb, and Zn. Soil in each area was analyzed to the 36-inch depth for total and dilute acid extractable concentrations of the trace elements. It was found that total concentrations of the elements in the 0 to 12-inch depth of soil were increased by sludge additions by the following factors: Al, 1.1; Cd, 35; Cu, 16.5; Fe, 1.1; Mn, 1.2; Ni, 2; Pb, 16.5; and Zn, 13. However, although these large amounts of trace elements accumulated in the soil, they did not accumulate significantly in the grain of corn plants grown in the treated soil when compared to control plants. The roots of the plants did contain large amounts of the elements, and concentrations of Cd and Cu in the leaves were found to be higher than normal.

*Pollutant identification, Toxicity, Municipal wastes, Sludge disposal, Sewage disposal, Analytical techniques

E093
INSTRUMENTATION AND AUTOMATION OF WASTEWATER TREATMENT SYSTEMS,

Rossler, J. F., and Wise, R. H.

Advanced Waste Treatment Research Laboratory,
Environmental Protection Agency,
Cincinnati, Ohio.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1369-1381, June, 1975. 136 ref.

Recent literature on automation systems for waste water treatment systems and on related instrumentation is reviewed. Process stream analyzers and sensors have been designed to measure substrate, physical and chemical properties, suspended solids, and biological activity. Monitoring of organic loads in waste water process streams by instrumented on-line analyses of total carbon, total organic carbon (TOC), and total oxygen demand (TOD) rather than by manually determined BOD is discussed. Widespread usage of on-line commercially available process stream analyzers is expected over the next ten years. These include equipment for monitoring nitrate-nitrite, ammonia, orthophosphorus, and total hydrolyzable phosphorus. Current techniques involving continuous pressure sensors are reviewed, including applications in flow and level measurements, density, viscosity, consistency, and leak detection. Advantages and disadvantages of various automatic control systems for waste water treatment processes are detailed. Mathematical models and control strategy simulations may be used to predict system responses. Available microcomputers and minicomputers for programmed data acquisition and operational control were also surveyed.

*Automation, *Instrumentation, *Waste water treatment, *Reviews, Analytical techniques, Monitoring, Measurement, Control systems, Computers, Pollutant identification

Process stream analyzers, Sensors

E094
GAS CHROMATOGRAPHIC (ECD) DETERMINATION OF COPROSTANOL AND CHOLESTEROL AS INDICATORS OF FECAL POLLUTION IN WATER,

Matsushima, H., Wakimoto, T., and Tatsukawa, R.

Ehime University,
Tokyo, Japan,
Department of Chemistry.

Bunseki Kagaku, Vol. 24, No. 6, p 342-345, June, 1975. 3 fig, 1 tab, 4 ref.

A gas chromatographic method for the determination of coprostanol and cholesterol as indicators of fecal pollution in water is described. Coprostanol (5 beta-cholestan-3 beta-ol) is one of the major fecal sterols excreted by man and livestock and is a good indicator of fecal pollution. Thus, the method is applicable to the determination of trace amounts of coprostanol in seawater in order to monitor the disposal of human and animal wastes in the marine environment. Coprostanol and cholesterol extracted with n-hexane were silylated with bromomethyldimethylchlorosilane (BMDS); reaction products were determined by a gas chromatograph equipped with an electron capture detector. The detection limits were 10 ng/liter for coprostanol and 20 ng/liter for cholesterol. These limits were 10,000 times less than those of the conventional procedure.

*Pollutant identification, *Water pollution sources, *Gas chromatography, *Monitoring, Environmental effects, Waste disposal

Coprostanol, Cholesterol, Human wastes, Fecal pollution, Electron capture detector

E095
NEW ORLEANS DRINKING WATER SOURCES TESTED BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY, OCCURRENCE AND ORIGIN OF AROMATICS AND HALOGENATED ALIPHATIC HYDROCARBONS,

Dowty, B. J., Carlisle, D. R., and Laseter, J. L.

New Orleans University, Lakefront, New Orleans, Louisiana, Department of Biological Sciences.

Environmental Science and Technology, Vol. 9, No. 8, p 762-765, August, 1975. 3 fig, 3 tab, 9 ref.

Low molecular weight volatile organic compounds were thermally extracted from water samples before, during, and after processing by a New Orleans, La., municipal water treatment plant. Bottled artesian water and water from a charcoal filtering-deionizing unit were also examined. The volatile components were trapped on a solid polyphenyl ether adsorbent and resolved by high resolution gas chromatography. A gas chromatograph-mass spectrometer-computer combination was used to identify major aromatic and halogenated aliphatic components. About 70 organic constituents can be detected in any single analysis of liter size. Most of these organics are either aromatic or halogenated aliphatic and aromatic. The major constituents of finished water are benzene, carbon tetrachloride, dichloroethane, bromodichloromethane, and chloroform. The concentrations of many halogenated and aromatic organics such as trichloroethylene, 2- or 1-naphthyl-dichloromethane, and xylene are unchanged by passing through the treatment plant. The concentrations of dichloroethylene, chloroform, benzene, carbon tetrachloride, dichloroethane, bromodichloromethane, toluene, and dibromochloromethane are enhanced greatly in the water treatment process. This increase in concentrations indicates that they are formed by chlorination of precursor organic molecules. The organics in the bottled artesian water were the same as those in the finished water. Variations in organics present and their relative concentrations varied from bottle to bottle. The preliminary data suggests that further studies are needed to determine the value of charcoal filtering for potable water production.

*Water analysis, *Organic compounds, Potable water, Water sources, Analytical techniques, Pollutant identification, Water pollution sources, Chlorination, Gas chromatography, Mass spectrophotometry

Chlorinated hydrocarbons, New Orleans (La)

E096
DEVELOPMENT OF A GROSS POLLUTION DETECTOR: LABORATORY STUDIES,

Holland, G. J., and Green, A.

Water Treatment and Examination, Vol. 24, Part 2, p 81-99, 1975. 6 fig, 6 tab, 4 ref, 2 append.

The development and testing of a gross pollution detector (GPD) is discussed. The monitoring system was based on a continuously operating percolating filter in which nitrifying organisms were selectively cultured. A specific-ion electrode was used to indicate changes in the rate of nitrification of ammonia. Numerous compounds have been found which could inhibit nitrification. The media was carefully graded 20 mm granite chippings, supported in a PVC tube. The term "Toxicity threshold concentration" was devised from the relative toxicities of the substances tested and means "that concentration of pollutant which will bring about a 50% inhibition of nitrification". The toxicity threshold concentration is determined by plotting the maximum percentage inhibition against concentration for each of the concentrations used and determining the concentration that would result in 50% inhibition. The investigation showed the basic soundness of the concept of using the automatic detection of the inhibition of nitrification as a warning of the presence of pollution. More evaluations of this monitoring system should be performed.

*Monitoring, *Water pollution, *Nitrification, *Ammonia, *Pollutant identification, Rivers, Toxins, Water pollution sources, Water quality, Analytical techniques

Ammonia-ion electrode

E097
ORGANIC CONTAMINANTS IN WATER SUPPLIES,

American Water Works Association Journal, Vol. 67, No. 8, p 418-424, August, 1975. 5 fig, 3 tab, 12 ref.

The findings of the subcommittees of the AWWA Committee on Organic Contaminants in the areas of organic contaminants in water supplies and the status of detection methods are reported. Standard monitoring procedures for organic contaminants involve three variations of the carbon adsorption method (CAM): the high-flow CAM (CAM-hf); the low-flow CAM (CAM-lf); and, the organics-carbon adsorbable (O-CA) test. The following recommendations were offered by the committee. The organic contaminant content of the water should be monitored continuously before and after treatment. The O-CA technique seems to be a promising technique for this monitoring. The historical carbon chloroform extract (CCE) and carbon alcohol extract (CAE) data retrieved from STORET should be subjected to extensive study and statistical evaluation. The concentration and cleanup step in the analysis of trace organics needs to be thoroughly investigated. Available procedures for this step, such as carbon or macromolecular resin adsorption, freeze concentration, and solvent extraction, should be qualitatively and quantitatively evaluated, improved, and possibly automated to facilitate wider application. Research should be performed to improve rapid gas chromatography techniques for water quality control. The interfaced gas chromatograph-mass spectrometer-computer system for organic analysis should be further developed. Its application in water treatment should be demonstrated.

*Water treatment, *Organic compounds, *Monitoring, *Pollutant identification, *Analytical techniques, Water analysis, Chemical analysis, Potable water, Water quality control, Gas chromatography

Carbon adsorption method, High-flow CAM, Low-flow CAM, Organics-carbon adsorbable test, Carbon chloroform extract (CEE), Carbon alcohol extract (CAE)

E098
RECENT TRENDS OF INSTRUMENTATION, CONTROL, AND AUTOMATION SYSTEMS FOR WASTEWATER TREATMENT SYSTEMS (Gesuido shisutemu seigyo no doko),

Kato, S., and Oto, T.

Hitachi Hyoron, Vol. 57, No. 2, p 3-7, February, 1975. 5 fig, 11 ref.

Recent trends of instrumentation, control, and automation systems for waste water treatment are described. The establishment of a better sewage system in Japan is urgently needed, with advanced treatment of sewage in large cities necessary because of the increasing populations of these cities. An effective reutilization of waste water is required, and may be accomplished by the establishment of different water lines for different types of water usage. For better control in waste water treatment plants, the concept of a hierarchical system should be employed, in which all controlling units for individual steps in water treatment are interrelated. The use of a computer is essential for this control system. The advantages of such a system are the high reliability and flexibility of the control system in cases of partial malfunctionings of treatment units. Another advantage is the high efficiency in controlling waste water treatment, particularly for large scale treatment plants.

*Instrumentation, *Waste water treatment, *Automation, *Control systems, Sewage treatment, Water treatment, Computers, Treatment facilities, Tertiary treatment

Japan

E099
WATER MONITORING STATIONS,

Johnson, J. O., Jr.

Water and Sewage Works, Reference Number, p R178, R180-182, R184-R185, April 30, 1975. 11 fig, 10 ref.

Equipment and systems for monitoring water quality parameters both in plant and streamside are discussed. In-situ system measurement makes use of a submersible cluster of sensors which measure the parameters at the point of submersion. This is a simple system to use when environmental conditions permit. The most common method of obtaining water samples is to pump water from the source to some location where the sensors are housed. This system is characterized by the separately mounted pump with piping to the measuring equipment which is located in a separate shelter or space within the plant. The factors which aid in determining the location of the sampling site and the mounting and anchoring facilities include the type of water, annual water level data, and flood level and flood history. The kind of debris that may be in the water course should also be considered when choosing the type of equipment and site. The preferred pump is the positive displacement type. The most common method of mounting is to support the pump by a pipe from a pier, truss, bridge, or bulkhead. A pump can be mounted in a stillwell for protection from the weather. A slanted stillwell is becoming increasingly popular. Debris screens will help to keep the debris out of the system but many of the available screens are difficult to position and too small. The plumbing can be critical because of the debris. The piping should be laid out to minimize sharp bends, changes in cross section, and areas for sediment to collect. The pressure regulation that most systems require in order to function properly can be accomplished with a bypass or discharge valve.

*Waste water treatment, *Monitoring, *Measurement, Instrumentation, Equipment, Water quality control, Pumps, Pipelines, Data transmission

E100
EVALUATION OF NEW REVERSE OSMOSIS MEMBRANES FOR THE SEPARATION OF TOXIC COMPOUNDS FROM WASTEWATER, SECOND ANNUAL SUMMARY REPORT,

Chian, E. S. K., and Fang, H. P. H.

Illinois University,
Urbana.

Technical Report No. UILU-ENG-74-2028, October, 1974. 103 p, 17 fig, 34 tab, 18 ref, 3 append.

Results of the second year of a study on the evaluation of reverse osmosis membranes for separation of toxic compounds from waste water are presented. In previous study, it was determined that the best results in treating waste water consisting of various small polar organic compounds were accomplished with the use of NS-100 membranes and aromatic polyamide membranes. While both showed excellent results in removing either organic or inorganic solutes, the NS-100 had a flux of a higher magnitude and was chemically and biologically more stable than the aromatic polyamide membrane. Thus, an extensive study was conducted on the characteristics of the NS-100 membrane, including the formulation of mathematical models to predict its performance under various conditions. Also, a comparison between newly developed reverse osmosis membranes obtained from other laboratories was made, such as NS-200 and PBI, but NS-100 proved superior in performance. The tests on the NS-100 membrane included its performance in the removal of pesticides, thirteen model compounds, alcohols, fatty acids, amines; the effects of pH on the performance of the membrane; and optimization of membrane performance as demonstrated by factorial and other design criteria; and the resistance of the NS-100 membrane to chlorine.

*Membrane processes, *Reverse osmosis, *Waste water treatment, Organic compounds, Laboratory investigation, Mathematical studies, Design criteria, Analytical techniques

NS-100 membrane, Toxic compounds, Factorial analysis

E101
CHEMICAL COMPOSITION OF ORGANIC COMPOUNDS PRESENT IN WATER OF THE TAMAGAWA RIVER,

Ogura, N., Ambe, Y., and Ogura, K.

Rikusui Gaku Zasshi, Vol. 36, No. 1, p 23-30, January, 1975. 2 fig, 7 tab, 17 ref.

An investigation was conducted to determine the chemical composition of dissolved organic matter (DOM) in the water of the Tamagawa River, near Tokyo, in November 1972 and May and November 1973. Samples were filtered through glass fiber filters for analysis. The percentage of each chemical component to the total DOM was as follows: carbohydrates, 16-18%; protein, 29-36% (amino acids, 25%); lipids, 3%; urea, 1%; and ABS, 9-16%. The percentage of protein (nitrogen containing compounds) was larger and that of lipids (ether extractable compounds) was smaller than had been observed in seawater samples. ABS derived from detergents was also present in large amounts in the Tamagawa River samples. In addition, trace organic compounds including fatty acids, sterols, polyaromatic hydrocarbons, BHC and phthalate esters were found in these samples.

*Organic matter, *Rivers, *Pollutant identification, Filtration, Detergents, Organic compounds

Dissolved organic matter, Japan, Tamagawa River

E102
DETERMINATION OF ORGANIC CARBON IN WATER USING A PCO2 ELECTRODE,

Noshiro, M., and Yarita, T.

Asahi Glass Company,
Yokohama-shi, Kanagawa, Japan,
Research Laboratory.

Bunseki Kagaku, Vol. 24, No. 6, p 390-391, June, 1975. 1 fig, 1 tab.

The concentration of total organic carbon in water may be measured with a PCO2 electrode as a sensor. The feasibility of this method was studied. Because nitrogen in air is converted into NOx which interferes with the PCO2 measurement, oxygen carrier gas (300 ml/min) rather than air, was used. A sample combustion chamber was maintained at 800 C and an oxidation chamber was operated at 600 C. Carbonaceous materials were oxidized to carbon dioxide with a Pt-Rh catalyst on alumina; water vapor was removed at room temperature by a cooling trap; carbon dioxide was absorbed in 2 ml of 0.5 M NaOH solution. The solution was acidified with one ml of 2 M HCl and introduced into a cell, where the potential of a PCO2 electrode could be measured. The content of total organic carbon in the sample was calculated from a calibration curve obtained with the standard solution in the same manner. Analysis time was about eight minutes, precision about plus or minus 20%.

*Organic matter, *Pollutant identification, Electrodes, Analytical techniques, Measurement

*Total organic carbon, Sensors, PCO2 measurement

E103
DEVELOPMENT OF A GROSS POLLUTION DETECTOR: FIELD TRIALS,

Stroud, K. C. G., and Jones, D. B.

Water Treatment and Examination, Vol. 24, Part 2, p 100-119, 1975. 7 fig, 1 ref, 1 append.

A detector for gross pollution in rivers was developed by the Severn-Trent Water Authority, Great Britain. The operating principle of the detector is based on the inhibition of pollutants by bacteriological oxidation of ammonia in a nitrifying column. Field trials on a series of rivers were conducted in order: to identify and try to overcome problems associated with using the gross pollution detector on actual river sites; to determine if the detector could be developed into a reliable plant which could be installed at any station; and to learn how well the detector operated on rivers carrying a range of pollution loads. Field trials were conducted on the Rivers Severn, a relatively unpolluted river but one often having high turbidity and used for water supply; Bourne, a smaller river used for potable water, carrying effluents from several sewage works, having heavy silt during flood periods; Blythe, having a high proportion of sewage effluents for a potable water source; Cole, polluted and not a water supply source; and Tame, badly polluted. After two years of trials and improvements, the reliability of the nitrifying column and the specific ion electrode for ammonia were demonstrated. Once the nitrifying column had achieved its optimum efficiency it ran for several months continuously and the ammonia concentration in the effluents was not affected by other river characteristics.

*Rivers, Pollutant identification, On-site tests, Potable water, Effluents, Ammonia, Waste water treatment

Gross Pollution Defector

E104
MEASUREMENT OF POWER INPUT IN FLOCCULATION,

Bhole, A. G., Dhabadgaonkar, S. M., and Tarnekar, S. G.

Visvesvaraya Regional College of Engineering,
Nagpur, India.

Journal of the Institution of Engineers (India), Vol. 55, Part PH2, p 37-39, February, 1975. 5 fig, 1 tab, 11 ref.

In the treatment of water, flocculation is commonly utilized for removal of turbidity. When mechanical mixing is used to achieve flocculation, a proper coagulant dose is necessary. Velocity gradient (change in velocity per unit distance normal to the direction of velocity) has been accepted as a rational parameter. It is assumed that the performance of a field flocculator is the same as that in an (empirical) jar test of the velocity gradient. A method used in India is presented for measuring mean temporal velocity gradient by the power input technique. The Ward-Leonard method of speed control was used to regulate the speed of a 220 V dc and 0.75 amp universal motor, to which the flocculator shaft was attached.

*Water treatment, *Flocculation, *Measurement, Equipment, Turbidity, Analytical technique

*Speed regulation, *Velocity gradient

E105
X-RAY FLUORESCENCE ANALYSIS OF TRACE METALS IN WATER BY MEANS OF CONDENSATION DEPENDING ON ADSORPTION BY ACTIVE CARBON (Kassei tan kyuchakuho ni yoru suichu biryo kinzoku genso no keiko X-sen bunseki),

Yamaguchi, M., and Shiio, H.

Nagoya-shi Kogyo Kenyusho Kenkyo Hokoku, No. 53, p 5-8, 1975. 10 fig, 1 tab, 5 ref.

The trace metals Cu, Ni, and Cr in water were analyzed by chelation with EDTA, followed by adsorption on activated carbon, placement of the carbons on coated filter paper with PVA, and x-ray spectrography. The x-ray intensity of adsorbed activated carbon with the chelated metals was two times that of non-chelated metals. The sensitivities, when 0.2 g activated carbon were added to 100 ml analytical water, were 0.1 ppm for copper, 0.04 ppm for nickel, and 0.04 ppm for chromium. The three types of trace metals may be analyzed by x-ray techniques simultaneously, as one does not affect the accuracy of the measurement of the others.

*Metals, *Copper, Nickel, Chromium, Analytical techniques, Spectroscopy, X-ray spectroscopy, Chelation

Japan, EDTA, Trace metals

E106
EXPERIENCE WITH THE DETERMINATION OF THE BIOCHEMICAL OXYGEN DEMAND WITH SPECIAL CONSIDERATION OF THE MODIFIED 'VIEHL DILUTION METHOD' (ERFAHRUNGEN MIT DER BESTIMMUNG DES BIOCHEMISCHEN SAUERSTOFFBEDARFS UNTER BESONDERER BERUECKSICHTIGUNG DER MODIFIZIERTEN VIEHL'SCHEN VERDUENNUNGSMETHODE),

Boehmke, S.

Das Papier, Vol. 29, No. 8, p 358-362, August, 1975. 2 fig, 1 tab, 18 ref.

An improved variation of Viehl's method for the determination of the biochemical oxygen demand (BOD) in waste waters is described. A water sample which contains adapted microorganisms and nutrient salts is enriched with oxygen to a concentration of 20 mg/liter rather than to 35 mg/liter. A nitrification inhibitor (N-allylthiourea) is added at a rate of 0.6 mg/liter. The determination and calculation are simplified by the use of a special 100 ml-flask. Frequently occurring errors that result from the dilution effect can be avoided if the oxygen consumption used for the BOD calculation is between 30 and 70% of the original oxygen content.

*Biochemical oxygen demand, *Waste water treatment, *Analytical techniques, Microorganisms, Oxygen, Pollutant identification

Viehl's Method

E107
WATER POLLUTION MONITORING SYSTEM,

Matsuda, M., and Takeda, Y.

Nippon Denki Giho, No. 2, p 73-81, March, 1975. 6 fig, 2 tab, 3 ref.

A system consisting of water pollution monitoring stations where data are collected on-line, and of a central monitoring station to which recorded cassette tapes are supplied for computer input has been developed in Japan. The stations are set up on rivers and lakes, at sea, and at the point of plant sewerage discharge. Data obtained at the monitoring stations include pollutant concentrations, water temperature, flow rate, oxidation-reduction potential, and electric conductivity. Pollutants included cadmium and Cd compounds, cyanides, organic phosphorus compounds, lead and Pb compounds, Cr(VI) compounds, arsenic and As compounds, mercury and Hg compounds (including alkylmercury), suspended solids, phenols, Cu, Zn, soluble Mn, n-hexane extracts, fluorides, coliform-group bacteria and BOD and COD. These were measured by standard Japanese (JIS) methods. Data were integrated at the central monitoring station by on-line, background, off-line, and backup computer operations.

*Monitoring, *Water pollution, *Computers, Analytical techniques, Pollutant identification, Heavy metals, Biochemical oxygen demand, Rivers, Lakes, Sewerage, Chemical oxygen demand, Data collection

E108
COMPARATIVE STUDY OF POLIOVIRUS CONCENTRATION METHODS FROM WATER (ESSAIS COMPARATIVES DE METHODES DE CONCENTRATION DU POLIOVIRUS A PARTIR DES EAUX),

Gulian, C., Mallet, M. N., Gevaudan, M. J., Blancard, A., and Charrel, J.

Techniques et Sciences Municipales--L'Eau, No. 5, p 205-208, May, 1975. 4 tab, 8 ref.

Two methods for the separation of poliovirus from different waste waters were studied. Filtration through a cellulose filter showed efficiencies of over 90% for waste waters with low organic matter content. However, very low efficiency was achieved for waste waters with a high content of organic substances. Adsorption of a polyelectrolyte PE 60 (polystyrene-divinylbenzene with an isobutylene maleic anhydride group) proved to be highly effective with efficiencies between 90 and 100% regardless of the organic matter content of the waste water. However, this method requires a pH value of 5.2. Slight deviations from this pH value result in considerable reduction of the separation efficiency.

*Pollutant identification, *Filtration, Viruses, Organic matter, Hydrogen ion concentration, Polyelectrolytes, Separation techniques, Waste water treatment

*Poliovirus

E109
THE MEASUREMENT OF MLSS USING INTEGRATED SPHERICAL TYPE TURBIDIMETER,

Ishihara, Y., Tanaka, K., and Sunahara, H.

Mizushori Gijutsu, Vol. 16, No. 7, p 659-662, July, 1975. 5 fig, 1 ref.

A pre-determined quantity of mixed activated sludge solution was sampled and diluted with water to a specified volume. After rapid stirring, the turbidity of the solution was measured by an integrated spherical type turbidimeter. The activated sludge in the solution was determined by a conventional method and a calibration curve was constructed. A standard solution of kaolin was used for the calibration of the turbidimeter. Results showed that both SEP-TW model and SEP-PT model turbidimeters gave satisfactory reproducibility and sensitivity. An ultra-sound wave method and a high speed mixer were found to give a homogeneously dispersed solution of activated sludge; a constant turbidity was obtained after 30 minutes of standing. Activated sludge at concentrations of up to 10,000 ppm can be measured by the turbidity method and any coloration of the sample solution with metal ions from zero to eight percent in concentration has no apparent effect on the determination.

*Measurement, *Analytical techniques, Activated sludge, Turbidity, Suspended solids, Pollutant identification

Mixed liquor suspended solids (MLSS)

E110
PHOSPHATE DEPENDENT FLOCCULANT DOSAGE AT PHOSPHORUS ELIMINATION FROM COMMUNAL WASTE WATER (DIE PHOSPHATFRACHT-ABHAENGIGE FAELLMITTEL-DOSIERUNG BEI DER PHOSPHOR-ELIMINATION AUS KOMMUNALEM ABWASSER),

Zerres, H., and Wagner, R.

Chemie Ingenieur Technik, Vol. 47, No. 13, p 562-565, 1975. 5 fig, 4 ref.

A method for determining phosphate load-dependent dosage of flocculants for phosphorus removal from municipal waste water is described. The dosage is dependent on the fluctuations in the phosphate load of the waste water. This method is based upon the continuous photometric measurement of the phosphorus concentration in the waste water by a molybdate-vanadate method, and on the measurement of the waste water flow. The signal obtained is used to control the rotation speed of the flocculant proportioning unit, and thus to determine the actual phosphate load. This method has been successfully tested at a waste water treatment plant.

*Flocculation, *Phosphates, *Waste water treatment, *Nutrient removal, Measurement, Flow, Treatment facilities, Photometry, Pollutant identification

Flocculant dosage, Phosphate removal

E111
A TRIAL OF APPLICATION OF A IONOSELECTIVE ELECTRODE FOR NITRATE DETERMINATION IN SANITARY-HYGIENIC EXAMINATIONS OF WATER (PROBA ZASTOSOWANIA ELEKTRODY JONOSELEKTYWNEJ DO OZNACZANIA AZOTANOW W SANITARNYM BADANIU WODY),

Nowak, K., and Luczak, J.

Roczniki Panstwowego Zakladu Higiency, Vol. 26, No. 3, p 401-405, 1975. 1 fig, 1 tab, 6 ref.

Two methods for the determination of nitrate-nitrogen in water, the colorimetric method and a ionoselective nitrate electrode technique, were comparatively investigated. The results of measurements by both methods were in the closest agreement in the range of nitrate-nitrogen concentration greater than 1.0 mg/liter. This range is particularly important for the public health specialist.

*Pollutant identification, *Analytical techniques, Colorimetry, Electrodes, Nitrogen, Public health, Selectivity

Ionoselective nitrate electrode, Nitrate-nitrogen

E112
LEAD, ZINC, AND COPPER IN SOILS OF URBAN STORM-RUNOFF RETENTION BASINS,

Nightingale, H. I.

American Water Works Association Journal, Vol. 67, No. 8, p 443-446, August, 1975. 3 fig, 4 tab, 13 ref.

Sixteen widely distributed storm drainage retention basins were used for the analysis of their soils in terms of lead, zinc, and copper, which had accumulated from urban storm runoff. Street surface contaminates tend to accumulate in these confined basin areas. It was found that lead, zinc, and possibly copper accumulated in large amounts in the first few centimeters of soil (0 to 5 cm), in lesser amounts at the 5 to 15 cm depth, and at natural background levels in the 15 to 30 cm soil depth intervals. Lead accumulation was especially evident, as a result of street runoff, and was detected in amounts large enough so as to be a severe health hazard. If lead is not removed from gasoline, eventually lead-contaminated soil in the retention basins used for recreation will have to be mechanically removed. Zinc and copper concentrations in the soils did not constitute an environmental health hazard for recreational or groundwater recharge use of these basins.

*Storm runoff, *Urban runoff, *Lead, *Zinc, *Copper, Retention, Flood control, Soils, Groundwater, Recharge, Heavy metals, Drainage, Water management (applied), Public health, Pollutant identification, Analytical techniques

Retention basins

E113
AQUEOUS COMPLEXATION OF COPPER WITH SEWAGE AND NATURALLY OCCURRING ORGANICS,

Culp, B. R.

Dissertation Abstracts International B., Vol. 36, No. 3, p 1118, 1975.

Heavy metal distribution and speciation in natural and waste water was investigated. Copper was selected as a heavy metal typically found in both municipal and industrial waste effluents. Experiments were conducted to determine the interaction of copper with inorganic and organic complexing ligands found in sewage and in receiving waters. Differential pulse anodic stripping voltammetry was used for an assessment of the metal-organic binding capacity of copper in sewage and process effluents. This capacity was measured for effluents from four sewage treatment plants in Washtenaw County, Michigan. The organic content of the sewage (as quantified by TOC, COD, and BOD) was found to affect the degree of complexation. Data suggested that the chemical parameters of TOC and COD might be used to predict binding capacity from one plant to another. Samples of raw influent and final effluent sewage were freeze-concentrated and fractionated by gel chromatography; molecular weight fractions suggested that copper binding is dependent on the degree of biodegradability of the organic material. With new methodologies for assessing metal distribution and speciation, it is suggested that heavy metal characterization in terms of degree and type of their complex formation, can be used to predict the availability of metal micronutrients and toxicity of metals to the environment.

*Heavy metals, *Pollution identification, *Copper, *Analytical techniques, *Sewage effluents, Toxicity, Environmental effects, Municipal wastes, Industrial wastes, Treatment facilities, Chromatography, Molecular structure, Chemical oxygen demand

Gel chromatography

E114
SOME OBSERVATIONS CONCERNING PREPARATION AND STORAGE OF STREAM SAMPLES FOR DISSOLVED INORGANIC PHOSPHATE ANALYSIS,

Johnson, A. H., Bouldin, D. R., and Hergert, G. W.

Cornell University,
Ithaca, New York, Department of Agronomy.

Water Resources Research, Vol. 11, No. 4, 559-562, August, 1975. 3 fig, 4 tab, 9 ref.

The influence of storage conditions and duration of storage was studied for 100 stream samples. These samples were collected during various seasons and flow conditions. Dissolved molybdate reactive phosphorus, or DMRP, is specifically discussed. Samples of stream water were frozen and, when subsamples were centrifuged and thawed, they showed lower concentrations of DMRP. Samples stored at 5 C showed varying concentrations with varying times of storage. A concentration decrease during the first two days was followed by an increase over a 1-2 month period. Microbial activity or sorption reactions may have caused the decrease. The increase which followed may have been due to the slow dissolution of iron phosphates which are present in the acid soils of the landscape (but are unstable in the stream water where the pH is at least 8), or to the release of phosphorus from organic combinations by microbial activity. Refrigeration of centrifuged samples was also unsatisfactory, because they showed a decrease in DMRP concentration. Samples with the most DMRP showed the most decrease. Aqueous techniques were acceptable for measuring DMRP concentrations, but analysis must be done soon after sampling for an accurate estimation.

*Freeze-thaw tests, Centrifugation, Refrigeration, Sampling, Streams, Analytical techniques, Storage

*Sample storage, *Inorganic phosphate analysis, Dissolved molybdate reactive phosphorus, Fall Creek (NY), Aqueous techniques

E115
CHARACTERIZATION OF AROMATIC HYDROCARBONS (CHARAKTERISIERUNG AROMATISCHER KOHLENWASSERSTOFFE)

Giger, W., Reinhard, M., and Schaffner, C.

Vom Wasser, Vol. 43, p 343-359, 1974. 7 fig, 1 tab, 10 ref.

Aromatic hydrocarbons are known to be common environmental pollutants. It is usually difficult if not impossible to establish the origin of these hydrocarbons. Their source may be spills of fossil fuels or fallout of incompletely combusted organic material, or wastes from trade and industry. Analytical methods for detecting aromatic hydrocarbons are outlined. A detailed discussion is presented on a method based on a combined system of gas chromatography and mass spectrometry. The data handling for this technique is performed by an on-line coupled computer. Domestic sewage, diesel fuel, and sediment recently contaminated by oil were anlyzed by this method. An extensive characterization of the aromatic hydrocarbon mixtures in sewage and sediment samples permits the identification of their origin.

*Pollutant identification, *Analytical techniques, *Oil wastes, Aromatic compounds, Sewage, Fuels, Water pollution sources, Industrial wastes, Computers, Gas chromatography, Mass spectrometry

Aromatic hydrocarbons

E116
ENTERIC VIRUS BEHAVIOR IN SAND DUNES,

Lefler, E., and Kott, Y.

Technion--Israel Institute of Technology,
Haifa, Israel,
Environmental Engineering Laboratories.

Israel Journal of Technology, Vol. 12, No. 5/6, p 298-304, 1974. 3 fig, 6 tab, 17 ref.

One step in a method of waste water treatment in the planned Dan, Israel, sewage reclamation project is to infiltrate the water through sand dunes and pump the recharged water after a lag period of 400 to 800 days. Very little laboratory data exists on the investigation of groundwater viral pollution, and the possibilities of public health problems from waste water reuse. This laboratory study was conducted to obtain a better understanding about the relationship between viruses and the infiltration area for future sewage reclamation projects. To investigate enteric virus behavior in sand dunes, bacteriophage f2 and attenuated poliovirus 1 were used as experimental viruses. Particles of these were introduced into sand columns 4 x 10 cm. The influence of various cation concentrations were examined for virus retention. No increase of eluted polioviruses were seen in batch experiments, using several eluents with different pH values. While 95% of the retained viruses were released in the first four washes, the sand still contained poliovirus particles after ten successive washings. Experiments with ions indicated that only bivalent cations (which exist in effective concentration in tap water) such as Ca^{++} and Mg^{++} may be responsible for virus retention in sand. This should be considered in planning waste water reuse through infiltration through sand dunes, to prevent seasonal virus breakthrough into the groundwater due to rains which have very low ion concentrations.

*Water reuse, *Waste water treatment, Recharge, Viruses, Public health, Laboratory tests, Groundwater, Infiltration, Ions, Analytical techniques

Sand dunes, Sewage reclamation, Israel

E117
A NEW METHOD FOR DETERMINATION OF ORGANICALLY BOUND CARBON IN WATER BY PHOTOCHEMICAL OXIDATION (EIN NEUES VERFAHREN ZUR BESTIMMUNG VON ORGANISCH GEBUNDENEM KOHLENSTOFF IN WASSER DURCH PHOTOCHEMISCHE OXIDATION),

Woelfel, P., and Sontheimer, H.

Vom Wasser, Vol. 43, p 315-325, 1974. 7 fig, 11 ref.

Dissolved organic carbon may be determined by a new method presented. Organic carbon compounds are oxidized at 40 C by means of ultraviolet radiation. The radiation source is a special low-pressure mercury lamp, which is submerged in the reactor. The instrument is sensitive enough to detect 0.001 mg of dissolved organic carbon in one liter of water. Each analysis provides a characterization of the particular organic material of the sample, because of the different rates of oxidation of various organic substances.

*Organic compounds, *Dissolved solids, *Analytical techniques, Ultraviolet radiation, Irradiation, Oxidation, Pollutant identification, Rates

*Photochemical oxidation, Organic carbon, Oxidation rates

E118
OBSERVATIONS ON THE ASSOCIATION BETWEEN MERCURY AND ORGANIC MATTER DISSOLVED IN NATURAL WATERS,

Andren, A. W., and Harriss, R. C.

Florida State University,
Tallahassee,
Department of Oceanography.

Geochimica et Cosmochimica Acta, Vol. 39, No. 9, p 1253-1258, September, 1975. 3 fig, 1 tab, 38 ref.

An investigation was made on the association of mercury with dissolved organic matter and the effect of salinity variations on the forms and transport of dissolved mercury from fresh water to marine environments. Samples of estuarine environments were taken from the Mississippi Delta and from the Florida Everglades. It was found that dissolved mercury in estuarine waters from these two areas is associated with dissolved organic matter which has the properties of fulvic matter found in soils. The role of methylmercury in the transport of dissolved mercury was insignificant in these estuarine streams. In the Mississippi River, most of the dissolved mercury and most of the dissolved organic carbon existed in the less than 500 molecular size cut-off fraction. Molecular size distribution for both organic carbon and mercury showed very little change across the salinity gradient. The Everglades waters, with a very high dissolved organic carbon content, may be partially regulated for dissolved mercury by coprecipitation with large organic molecules. From both observed and experimental evidence, it was indicated that mercury is not readily exchangeable from dissolved organic matter in the transition from fresh water to sea water.

*Mercury, *Salinity, *Organic matter, *Fresh water, *Estuarine environment, Mississippi River, Florida, Dissolved solids, Analytical techniques, Pollutant identification

Fulvic matter, Organic carbon

E119
EVALUATION OF A SINGLE-STEP BACTERIAL POLLUTION MONITOR,

Cotton, R. A., Sladek, K. L., and Sohn, B. I.

Millipore Corporation, Bedford, Massachusetts.

American Water Works Association Journal, Vol. 67, No. 8, p 449-451, August, 1975. 4 fig, 3 tab, 6 ref.

A single step bacterial pollution monitor is discussed and evaluated. This monitor is a self-contained filtration unit, nutrient supply and incubation chamber, and, when inmersed in water, samples a one ml aliquot. This was compared with standard membrane and filter techniques. Results with the new sampler compared favorably and were within statistical error of the standard tests. Statistical variations can be caused by the inherent randomness of sampling and by the variability of the test itself. This method of bacteriological testing can be useful when a simple, quick, and accurate test method is required.

*Membranes, *Filters, Water pollution, Statistical analysis, Bacteria, Monitoring, Sampling, Coliforms

*Bacterial pollution monitor, Millipore filters, Total-bacteria

E120
SOURCES OF POLLUTION FROM MILITARY INSTALLATIONS, PART II,

Wang, L. K., Michalovic, J. G., Ross, R. G., and Ciccone, V. J.

Water and Sewage Works, Vol. 122, No. 8, p 69-71, August, 1975. 12 tab, 21 ref.

Various waste water streams generated from military bases were analyzed and identified. Washrack waste waters are divided into two separate groups: materials in dirt films, such as soil, grease and oil; and detergents, soaps and solvents. General characteristics of waste waters are very similar despite the wide variability in differences of operation from installation to installation. Characteristics of various combined waste streams were studied. The chemical composition of a specific combined waste stream can be mathematically estimated if the quantity and the percent flow of each participating stream are known. Flow meters can be used to measure the flows of each participating waste stream at different times of day so that the combined waste waters may be estimated. The feasibility of this is subject to further field investigations.

*Waste water (pollution), *Water pollution sources, Pollutant identification, Oil, Detergents, Storm runoff, Phenols, Chemical oxygen demand, Biochemical oxygen demand, Mathematical estimating equations, Flow rates

*Military installations, Combined wastes, *Air Force bases, Washrack waste water, Total organic carbon (TOC)

E121
HEAVY METALS IN WATERS AND SOIL ASSOCIATED WITH SEVERAL PENNSYLVANIA LANDFILLS,

Suarez, D. L.

Dissertation Abstracts International B, Vol. 36, No. 3, p 1098, 1975.

Associated surface and subsurface water quality were examined for four Pennsylvania landfills in different hydrogeological settings. Two sites were in abandoned anthracite and bituminous coal strip mines; one was on shale, and the other was on a carbonate terrain. Concentrations of Fe, Mn, Cu, Zn, Ag, Pb, Cd, Cr, and Hg in water were greater than the maximum allowed. The anaerobic character and complexing properties of leach waters from solid wastes stripped large amounts of Fe and Mn and other associated trace metals from soils near the deposit sites. To characterize heavy metal associations with the Fe and Mn oxides, three sequential leaching steps were performed on the soils. Heavy metals in these soils occurred chiefly in Mn oxide coatings on quartz grains. Todorokite and geothite were the crystalline secondary oxide phases. The molar sorption capacity of the soil Fe oxides may be at least an order of magnitude lower than that of the soil Mn oxides.

*Heavy metals, *Pollutant identification, *Water quality, *Landfills, Coals, Shales, Carbonate, Isotherms, Anaerobic conditions, Leachate, Groundwater, Surface waters, Soil analysis, Pennsylvania

Todorokite, Geothite, Siderite

E122
LABORATORY STUDIES CONCERNING THE INFLUENCE OF THE TYPE OF ENERGY DISSIPATION ON THE AGGREGATION PROCESS (LABORUNTERSUCHUNGEN UEBER DEN EINFLUSS DER ART DES ENERGIEEINTRAGES AUF DEN FLOCKUNGSVORGANG),

Klute, R., and Hahn, H. H.

Vom Wasser, Vol. 43, p 215-235, 1974. 7 fig, 2 tab, 21 ref.

A description of the flocculation and coagulation processes in turbulent flow is presented. Because current systems require short reaction times and a diversity of coagulants are used, the effects of energy dissipation on the destabilization and transport phases is important. This study investigated whether the distribution of velocity gradients in the reaction chamber was significant, and would therefore invalidate the concept of an average linear velocity gradient. Two different clay suspensions were coagulated with Na^+, Ca^{2+}, and Hercofloc at a constant pH. In a jar test, turbine, propeller-type and anker-type stirrers were used; all three stirrers required the same energy input in the region of investigated speed. However, the coagulation rates for the stirrers were found to be different, contradicting the premise of an average linear velocity gradient. The anker-type stirrer provided the most uniform distribution of the turbulence. This is dependent upon floc properties, determined by the colloidal characteristics and the coagulant. It was concluded that the distribution of turbulence created by different stirrers in a reaction chamber is an important parameter to be considered.

*Flocculation, *Coagulation, Mixing, Laboratory tests, Turbidity, Flow characteristics, Analytical techniques

Floc properties, Colloidal characteristics

E123
THE EFFECT OF OZONE ON THE DISSOLVED ORGANIC SUBSTANCES IN THE WATER OF LAKE CONSTANCE (WIRKUNG VON OZON AUF DIE GELOESTEN ORGANISCHEN SUBSTANZEN IM BODENSEEWASSER),

Maier, D.

Vom Wasser, Vol. 43, p 127-160, 1974. 10 fig, 6 tab, 68 ref.

A determination of the characterization of organic substances in the water of Constance Lake before and after ozone treatment was presented. The effects of ozone were measured by summarized parameters of total organic carbon, chemical oxygen demand and ultraviolet spectra. Total acid determination was also made for the ozonized water of the lake. Further detail was given by IR-spectroscopic investigations. The influence of ozone treatment on successive steps of treatment was further studied in terms of adsorption with activated carbon, flocculation, chlorine demand, and the growth of bacteria.

*Organic matter, *Ozone, *Water treatment, *Waste water treatment, Flocculation, Pollutant identification, Lakes

Constance Lake

E124
MILILANI TOWN WASTEWATER RECLAMATION AND RECYCLING PROJECT,

Burbank, N. C., Jr.

Hawaii University, Honolulu, School of Public Health.

American Water Works Association Journal, Vol. 67, No. 9, p 487-489, September, 1975. 1 fig, 3 tab, 18 ref.

It had been estimated that Hawaii, which is served almost solely by groundwater supplies, had sufficient water until the year 2020. However, recent population and water use increases have outstripped these estimates. Four years ago a study of the reclamation and recycling of sewage waters for irrigation was started. A reevaluation of this study and a review of carbon chloroform extract (CCE) data is discussed. At the beginning of the study, CCE concentrations for rural, agricultural and wildlife areas indicated excellent water quality. DDT and other chlorinated hydrocarbons, indicated in other studies, were not found in detectable amounts. Infrared spectra of organic extracts were too complicated to be analyzed, but they did indicate the possible presence of phenols. Biochemical oxidation demand and chemical oxidation demand were used as indirect measurements of the amount of organic matter, but now direct destruction of carbon in the infrared detection total carbon oxidation unit can give a more direct measurement. Studies were performed at Mililani Town, Hawaii, on the feasibility of using sewage plant effluent for irrigation. To kill enteric viruses effectively very large amounts of chlorine are needed. Studies on an alternative material, virucide bromin chloride, are suggested. It was also found that data on CCE from sewage are scarce.

*Waste water treatment, *Reclamation, *Recycling, Groundwater, Pollutant identification, Irrigation, Biochemical oxidation demand, Chemical oxidation demand, Population, Sewage effluents, Sewage treatment, Viruses, Virucide, DDT, Chlorinated hydrocarbon pesticides, Phenols

Mililani Town (Haw), Infrared spectra, Carbon chloroform extract, Virucide bromin chloride

E125
COLORIMETRIC DETERMINATION OF CYANIDE, FLUORIDE AND SULFATE IN WATER,

Ramasamy, J.

Dissertation Abstracts International B, Vol. 36, No. 2, p 679-680, 1975.

Cyanide, fluoride, and sulfate in water were determined colorimetrically, with attention to the appropriate sensitivity, convenience, speed, and specificity. The permissible limit of cyanide in drinking water is 0.01 ppm. The Koenig reaction was employed for the determination of CN- by the oxidation of CN- to a cyanogen halide, CNX, in which CN+ was the reactive species. Because a fluoride concentration of 1.0 ppm results in a decrease of about 50% in the number of tooth cavities occurring in persons having used fluoridated water all their lives, this is an important substance to measure. The colorimetric reagent used in this study was an inverse complex Be4OR6, which can be visualized as neutral beryllium complex with oxygen, a Lewis base, being at the center of the complex instead of an acidic metal ion. Fluoride could be detected in the concentration range of 1.0 to 10 ppm. For the determination of sulfate, the ion was determined by displacement of violurate anion from barium violurate at a pH of 6.0 to 6.2 and spectrophotometric measurement of the violurate anion at 520 nm. Relatively high concentrations of sulfate are found in natural waters and extreme sensitivity in the method of detection is not required. Sulfate may be detected in the range of 30 to 900 ppm.

*Analytical techniques, *Pollutant identification, *Sulfates, *Fluorides, Colorimetry, Potable water, Spectrophotometry

*Cyanides

E126
WATER RENOVATION USING DEEP NATURAL SAND BEDS,

Aulenbach, D. B., Clesceri, N. L., Tofflemire, J., Beyer, S., and Hajas, L.

Rennselaer Polytechnic Institute, Troy, New York.

American Water Works Association Journal, Vol. 67, No. 9, p 510-515, September, 1975. 5 fig, 2 tab, 9 ref.

Waste water purified by the Lake George Village sewage treatment plant in New York was tested in order to determine whether the final effluent is being safely treated for its ultimate discharge into Lake George. Seepage from the banks of the flood plain of We Brook, which ultimately flows into the lake, was analyzed, and aerobic conditions were found in the groundwater between the treatment plant and West Brook. Samples taken from several wells and other locations were analyzed for temperature, dissolved oxygen, dissolved solids, pH, soluble phosphorus, NO3-N, NH3-N, coliforms and chlorides. These samples were made during each season, because the Lake George area has a seasonal increase in population due to summer tourism and a heavy runoff from spring snow melt. It was found that chlorides were not diminished, phosphorus was completely removed, and a nitrified effluent was produced which appears to have no obvious negative effects upon the Lake George water quality. Thus, effluent polishing using infiltration beds does achieve a sufficient degree of purification.

*Waste water treatment, *Sewage treatment, Infiltration, Flood plains, Effluents, Aerobic conditions, Pollutant identification, Groundwater, Nitrogen, Phosphorus, Treatment facilities

*Lake George (NY)

E127
ANALYTICAL DETERMINATION OF ORGANIC CHLORO-COMPOUNDS BY TEMPERATURE-PROGRAMMED PYROHYDROLYSIS (ZUR ANALYTISCHEN ERFASSUNG ORGANISCHER CHLORVERBINDUNGEN MIT DER TEMPERATURPRO-GRAMMIERTEN PYROHYDROLYSE),

Kuehn, W., and Sontheimer, H.

Vom Wasser, Vol. 43, p 327-341, 1974. 6 fig, 4 tab, 19 ref.

A proposed method for the analytical determination of organic chloro-compounds is described. Termed pyrohydrolysis, this method detects the total amount of chloro-compounds adsorbed on activated carbon. Inorganic chlorides may be eliminated by washing with NaNO3 solution. Besides measuring the total content of these organic compounds, the characterization of a specific composition may be found by measuring the desorption at different stages of temperature and time. Additionally, the mechanism of thermal decomposition of chloro-phenols on activated carbon was studied.

*Pollutant identification, *Analytical techniques, Organic compounds, Adsorption, Activated carbon, Phenols

Chlorine compounds, Pyrohydrolysis

E128
SURVIVAL OF ENTEROVIRUSES ON VEGETABLES IRRIGATED WITH CHLORINATED OXIDATION POND EFFLUENTS,

Kott, H., and Fishelson, L.

Technicon-Israel Institute of Technology, Haifa, Israel,
Department of Food Engineering and Biotechnology.

Israel Journal of Technology, Vol. 12, No. 5/6, p 290-297, 1974. 5 fig, 3 tab, 19 ref.

Laboratory experiments were conducted on the irrigation of tomatoes and parsley by oxidation pond effluents. In the laboratory, tomatoes and parsley were dipped in chlorinated and non-chlorinated oxidation pond effluents (OPE) and in Phosphate Buffered Saline (PBS) containing attenuated poliovirus 1 LSC. The samples were then exposed to changing climactic conditions and virus counts were taken at set intervals. Solar radiation had a significant effect on the viruses. A minimum of 0.35 cal/sq cm min was needed to effect the rate of inactivation of the virus on the vegetable surface. Exposure to sunlight and to chlorination had a large effect on the amount of virus found on the vegetables, and the combined effect was even greater. Vegetables contaminated by virus in PBS solution were also affected greatly by solar radiation. Samples kept in the dark as a test still showed virus present after 6 days, whereas no active virus were found on the vegetables after being outside and exposed to two radiation peaks in 28 h.

*Chlorination, Solar radiation, *Viruses, *Irrigation, *Effluents, Waste water (pollution), Pollutant identification, Oxidation lagoons, Ponds

*Oxidation pond effluents, Phosphate buffered saline, Poliovirus 1 LSC

E129
USE OF TEST WELLS AS WATER-QUALITY PREDICTORS,

Fetter, C. W., Jr.

Wisconsin University, Oshkosh,
Department of Geology.

American Water Works Association Journal, Vol. 67, No. 9, p 516-518, September, 1975.
8 fig, 1 tab.

Groundwater quality can vary from good to unacceptable over certain areas. The use of test wells as water quality predictors was studied. They can be especially useful in cased wells, where the majority of the expense lies in casing, the well screen, the gravel pack, the grouting, and the development. A test well, expensive as it may be, will be less expensive than the purification process that must be used on contaminated water. Another advantage is that the casing and screen for the test well can be used again in other test wells. The test wells discussed were built in Suffolk County on Long Island, where the groundwater can have large variations. The first stage in building a test well is drilling a test boring, either 12 in or 20 in in diameter. Core samples are taken and analyzed by a geologist every 10 or 20 feet. From the samples, the geologist will decide which zones or levels are suitable for testing. The hole is backfilled for the testing to take place. A complete chemical analysis is made on a sample of water taken from the well. Samples are analyzed for sodium, chloride, iron, hardness, alkalinity, and specific conductivity. In the eight test wells drilled on Long Island, the correlation with the permanent wells were excellent. Specific conductivity tended to be slightly higher in the permanent well than in the test well, as were concentrations of chloride, sodium, hardness and alkalinity, with very few exceptions. Iron tended to be less concentrated in the permanent well than in the test well.

*Test wells, *Water quality, Drilling, Groundwater, Water wells, Well casings, Well screens, Casings, Grouting, Water Pollution, Chemical analysis, Sodium, Chloride, Iron, Alkalinity, Specific conductivity, Pollutant identification

*Water quality predictors, Long Island (NY)

E130
CONTAMINANTS IN RAINWATER AND THEIR RELATION TO WATER QUALITY,
PART I,

Frizzola, J. A., and Baier, J. H.

Suffolk County, New York, Department of Environmental Control.

Water and Sewage Works, Vol. 122, No. 8, p 72-75, August, 1975. 1 fig, 2 tab.

The effect of rainwater quality on groundwater on Long Island is discussed. Long Island's sole water supply is groundwater, and the sole source of the groundwater is precipitation. Under natural conditions, about 50% of the precipitation is lost, mainly due to evapotranspiration, before it could become groundwater. The final quality of the groundwater is due not only to trace substances that may be picked up by rainwater in the atmosphere, but also by the hydrogeological processes that take place between the surface and the saturation point of the ground. Natural processes include: evapotranspiration, absorption, adsorption, and ion-exchange. Unnatural processes, termed pollution effects, include sources such as fertilizers, cesspools, leachate, and urban runoff. Precipitation study has experienced a resurgence lately, and the U.S. Geological Survey has developed a network of testing stations in New York State. The two stations discussed are Mineola and Upton in Long Island. To investigate the effects of lawn and garden fertilizers on groundwater the Suffolk County Department of Environmental Control set up a testing station at Medford, which is a flat area. Two types of samples are taken: a bulk monthly sample, and a sample of each precipitation event. Data analyses of samples were concerned with pH, nitrate, ammonia, sulfate, total nitrogen and chloride to sodium ion ratios, along with other ion tests.

*Rainwater, *Groundwater, *Water quality, Evapotranspiration, Pollutants, Precipitation (atmospheric), Analytical techniques, Water pollution sources, Water pollution effects

*Contaminants, Long Island (NY), Suffolk County Department of Environmental Control, U.S. Geological Survey

E131
TRACE METALS IN MELBOURNE RIVERS-AN INTERLABORATORY ANALYSIS,

Phillip, A. T., Pettis, R. W., Harris, J. E., Fabris, G. J., and Boar, P. L.

Materials Research Laboratories, Ascot Vale, Victoria, Australia.

Proceedings of the Royal Australian Chemical Institute, Vol. 42, No. 8, p 209-215, August, 1975. 1 fig, 5 tab.

Analytical techniques and procedures utilized in the study of trace metals in river, estuarine and oceanic waters are reviewed. Three independent Melbourne (Australia) laboratories conducted the experiments. Copper, lead and cadmium were the selected trace metals because of their high toxicity to a large variety of aquatic and marine biota. River water samples were taken from the surface of the Yarra and Maribyrnong Rivers at three stations. Two sets of water samples were made at a fourteen day interval. The first set of samples was put directly into the receptacles without acid addition. Two of the laboratories determined total metal content while the third one determined the dissolved-metal content. The second set was immediately acidified when collected. All three laboratories determined total metal content. Experimental procedures are described. The overall mean concentrations found were: copper 6.9 ± 1.5 microgram/liter, lead 5.4 ± 1.5 microgram/liter, and cadmium less than 0.5 microgram/liter. The results are comparatively similar to those found in various other streams in different parts of the world. These concentrations of the metals are considered to be below the safety level although they may be toxic to the more sensitive aquatic species. Further interlaboratory work is encouraged in order to establish accurate analytical procedures for trace metals and to further calibrate interlaboratory studies.

*Analytical techniques, *Heavy metals, *Pollutant identification, Estuaries, Oceans, Rivers, Sampling, Laboratory tests, Copper, Lead, Cadmium, Toxicity

E132
THE EFFECTS OF OZONE DEODORIZATION EQUIPMENT FOR THE SEWAGE ODOR (Gesui shuki ni taisuru ozon dasshusochi no koka),

Nishida, K., Honda, T., and Tsuji, T.

Akushu no Kenkyu, Vol. 4, No. 20, p 24-30, May, 1975. 5 tab, 11 ref.

The effectiveness of ozone deodorization equipment for eliminating sewage odors was determined. The concentrations of odor-causing compounds at a sewage treatment plant in Osaka, Japan, were measured before and after ozone treatment. The plant treated 4000 to 10,000 cu m gas per hr in an ozone reaction bath. The rate of ozone injected into the bath was 150 g/hr. The gas samples before and after the treatment were collected and analyzed by gas chromatography using a flame photometry detector and a PEG 20 M column. The ozone concentration injected into the bath was 1530 to 1710 ppm and the ozone level in the treated gas was 0.13 ppm. The residual ozone was treated at another bath, lowering the ozone concentration to below 0.01 ppm before the final discharge into the air. A gas chromatogram showed 12 peaks, indicating concentrations in the untreated gas of methyl mercaptan, 16.9 ppm; dimethyl sulfide, 1.30 ppm; hydrogen sulfide, 0.30 ppm; ammonia, 0.0052 ppm; trimethyl amine, less than 0.0005 ppm; n-propyl mercaptan, 31.3 ppm; and n-amyl mercaptan, 4.75 ppm. The concentrations of the corresponding compounds in the treated gas were: 12.6 to 12.8 ppm; 0.72 to 1.12 ppm; 0.29 to 0.0098 ppm; 0.0026 to 0.0047 ppm; less than 0.0005 ppm; less than 0.01 ppm; and 1.64 to 4.20 ppm. Thus, ozone removal efficiencies were 24.3 to 25.5% for methyl mercaptan; 13.9 to 44.6% for dimethyl sulfide; 3.4 to 96.8% for hydrogen sulfide; 9.7 to 30.8% for ammonia; better than 99.9% for n-propyl mercaptan; and 11.6 to 65.5% for n-amyl mercaptan.

*Ozone, *Sewage, *Odor, Waste water treatment, Sewage treatment, Equipment, Gas chromatography, Photometry, Treatment facilities, Analytical techniques, Measurement, Hydrogen sulfide, Ammonia

E133
WASTEWATER SAMPLE PRESERVATION,

Benedek, A., and Najak, A.

McMaster University,
Hamilton, Ontario,
Department of Chemical Engineering.

Water and Pollution Control, Vol. 113, No. 9, p 20-24, 31, September, 1975. 36 ref.

A summary is presented of sample preservation techniques for the major parameters of waste water, including BOD, COD, suspended solids, nitrates, nitrites, total nitrogen, ammonia, phenols, and phosphorus. The techniques are applicable in cases when waste water samples cannot be immediately analyzed. Because changes taking place in the samples are either biological or chemical, preservation serves to retard biological action, to inhibit precipitation and hydrolysis of chemical compounds, or to retard the volatility of various constituents. The physical methods commonly used are refrigeration or freezing. Several chemical methods are applicable, these are usually dependent upon the addition of metabolism suppresents. Tables are presented for each of the major waste water parameters, with a brief discussion and recommendation for each. For BOD, freezing or refrigeration is recommended, and values will tend to be low. For COD, acidification with sulfuric acid or freezing is suggested. Suspended solids are not preserved well and immediate analysis is the best alternative. Preservation of nitrates may be accomplished by refrigeration plus sulfuric acid. Ammonia may be preserved by refrigeration plus the addition of not more than 40 mg/liter mercuric chloride. Nitrites, however, should be analyzed immediately. For phenols, the addition of one g/liter copper sulfate, and acidification to pH 2 to 2.5, followed by storage in glass bottles with immediate refrigeration is recommended. Phosphates may be preserved by acidification plus refrigeration, while total phosphorus is best kept by acidification and freezing.

*Preservation, *Waste storage, *Biochemical oxygen demand, *Chemical oxygen demand, Nitrates, Nitrites, Nitrogen, Ammonia, Phenols, Phosphorus, Analytical techniques, Pollutant identification

Sample freezing, Waste water samples, Acidification

E134
THE EFFECT OF CIRCULATION BAFFLES ON THE OXYGENATING EFFECT OF AERATORS OPERATING IN HORIZONTAL POSITION (Wplyw przegrody cyrkulacyjnej na efekty natleniania urzadzen pracujacych na wale w pozycji poziomej),

Zymon, W.

Gaz, Woda i Technika Sanitarna, Vol. 49, No. 6, p 204-206, June, 1975. 5 fig, 1 tab, 8 ref.

Hydrodynamic analysis of liquid flow in oxygenation tanks and ditches, equipped with horizontal, rotary aerators, may be used to demonstrate the adverse effects of a poor circulation pattern on oxygeration rate, purification process, and power consumption. The principal deficiency discovered was the formation of a partial closed-cycle flow pattern in the immediate vicinity of the aerator which quickly becomes saturated with oxygen. This prevents efficient utilization of the entire available volume. Tests conducted in an experimental tank (dimensions 1.35 x 0.7 x 0.32 m) equipped with a 0.316 m diameter aerator, with flat blades 0.03 m wide, demonstrated that installation of a baffle at a depth of 0.03 to 0.05 m below the aerator, and inclined at an angle of 10 to 35 degrees with respect to the water surface, will change the circulation pattern and result in a good mixing of the entire volume of the chamber. The oxygenation rate becomes then a linear function of the depth of immersion and of rotational velocity of the aerator. Increases of 32 to 80% in oxygenation capability have been achieved, resulting in a possible efficiency of 5000 g 02/kWh.

*Flow, *Oxygenation, *Analytical techniques, *Hydrodynamics, Laboratory tests, Aeration, Water purification, Mixing

Horizontal rotary aerators, Oxygenation rates

E135
WASTE WATER TREATING OPERATION USING MICROBIAL MEMBRANE (I).
ANALYSIS OF RESISTANCE TO MOVEMENT WITHIN LIQUID PHASE,

Kubota, H., Omi, S., Tatsumi, H., and Waki, S.

Preprint of the Chemical Engineering Society, Tokyo, Japan, p 92-93, 1975. 4 fig, 2 tab, 1 ref.

The analysis of resistance to movement of oxygen in the liquid phase was carried out by batch operation using two types of microbial membrane supporters. The first type of supporter allowed the reaction solution to be circulated as a laminar flow. The second type alternated the flow path of the solution every 5 cm. A cultivated solution containing 100 ppm glucose, 100 ppm pepton, 100 ppm K_2HPO_4, 50 ppm $MgSO_4$, 50 ppm NH_3Cl and 10 ppm $FeCl_2$ was circulated at 25 C for 3 to 4 days at a pH of 7.0 to 7.2 to allow the microbial membrane to grow to about 100 microns. A solution containing 100 ppm glucose, 100 ppm K_2HPO_4, 50 ppm $MgSO_4$, 50 ppm NH_4Cl and 10 ppm $FeCl_2$ was used to substitute the cultivated solution, and the unreacted glucose was traced. The reduced sugar was analyzed by a Cu-colorimetric method. Results showed that flow rate significantly affected the reaction rate for the type one supporter but had no apparent effect on the type two supporter.

*Flow rates, *Analytical techniques, *Microorganisms, Membrane processes, Laminar flow

Resistance

E136
ESTIMATING SLUDGE PRODUCTION AIDS IN FACILITIES DESIGN,
PART II,

Benefield, L. D., Randall, C. W., and Sherrard, J. H.

Water and Sewage Works, Vol. 122, No. 9, p 100-102, September, 1975. 4 fig, 1 tab, 13 ref.

As the second part of a two-part series on estimating the production of sludge for the design of treatment facilities, a sample problem is presented. This involves the estimation of the volume of raw sludge from a completely mixed activated sludge plant treating a municipal waste water flow of 10 mgd, using anaerobic digestion for sludge stabilization. It is assumed that the influent waste water temperature is 20 C; several other waste water characteristics after grit removal are also outlined. A set of fourteen computations is presented, including: the volume of sludge removed during primary clarification in one day; the percent of BOD5 reduction during primary clarification; the observed yield coefficient, associated with a mean cell residence time of 16 days; the activated sludge production in one day; the concentration of the waste sludge when wasting is from the sludge line; the volumetric sludge wasting rate; volatile fraction of primary plus activated sludge mixture; the required digestion time for a digestion temperature of 80 F; the percent reduction in volatile solids during digestion; the weight of digested sludge produced in one day; the volume of digested sludge produced in one day; the volume of supernatant produced in one day; the influent BOD5 considering supernatant recycle; and the influent suspended solids concentration considering supernatant recycle.

*Treatment facilities, *Design criteria, *Activated sludge, *Waste water treatment, Anaerobic digestion, Mathematical studies, Model studies, Analytical techniques, Estimating equations

E137
MODIFICATION IMPROVE CHLORINE CONTACT CHAMBER PERFORMANCE,

Hart, F. L., Allen, R., DiAlesio, J., and Dzialo, J.

Worcester Polytechnic Institute,
Worcester, Massachusetts,
Civil Engineering Department.

Water and Sewage Works, Vol. 122, No. 9, p 73-75, September, 1975. 4 fig, 2 tab.

Studies have been conducted on modifications of the standard rectangular chlorine contact tank in order to improve the hydraulic efficiency. The two major variables in chlorine disinfection are concentration and time, and effective treatment is obtained by providing adequate dosage concentrations for the proper contact periods. While increasing dosages has been used as a method in the case of poor contact time, this practice has limitations because of problems caused by corrosive conditions experienced from too high concentrations, increased operating costs, and the inefficient utilization of chlorine. A successful chlorine contact chamber should achieve required disinfection levels as well as low operating costs and the discharge of an effluent safe for future uses. Two test evaluation methods are described for the modification of the standard chlorine contact tank to provide a more desirable hydraulic condition (plug flow). This modification is directly related to an increase in disinfection capability. Analysis was made of quantitative conventional dye tracer output response functions and qualitative evaluation of stream line flows. In order to modify the contact chamber, hydraulic performance of the prototype and unmodified chambers must be evaluated; areas of poor plug flow performance must be identified; and a series of systematic modifications can then be installed. Graphical presentations of the output response function data are presented; these demonstrated a hydraulic similarity between the model and field chlorine contact chambers.

*Chlorine, *Water treatment, *Disinfection, Operating costs, Analytical techniques, Hydraulics, Analytical techniques

Chlorine contact tanks

E138
NEW METHOD FOR THE DETERMINATION OF THE TOTAL BOD CONTENT OF WASTEWATERS (Novyy metod opredeleniya BPK-polnogo stochnykh vod),

Lur'e, Yu. Yu., and Odaryuk, V. A.

Vodosnabzhenie i Sanitarnaya Tekhnika, No. 7, p 28-29, 1975. 4 ref.

A method for the determination of the total BOD content of waste waters is described. The method is based upon the addition of ethylene thiourea, a nitrification inhibitor, in a concentration of 0.5 mg/liter; the other reagents are monobasic potassium phosphate, dibasic sodium phosphate, calcium chloride, ammonium chloride, magnesium sulfate, ferrous sulfate, and zinc sulfate. Static or air blowing variants of the method are possible. The pH value is between 6.5 and 7.5. The method is applicable to any waste water, and dilution is necessary only at organic matter contents over 3000 mg/liter based on the COD value. The time requirement for the BOD determination was reduced by 2 to 10 times as compared with the dilution method.

*Biochemical oxygen demand, *Analytical techniques, *Pollutant identification, Hydrogen ion concentration, Chemical oxygen demand, Organic matter, Inhibitors

*Ethylene thiourea, Nitrification inhibitors, Reagents

E139
HORSHAM TESTS COMPLETE,

Surveyor, Vol. 146, No. 4343, p 44, September 5, 1975.

Laboratory tests have been conducted on a model of the sump of the new Horsham sewage works. This test program was an integral part of Sigmund Pulsometer Projects' £420,000 contract to supply the pumps and ancillary equipment. New sewage works at Horsham are being built for the Southern Water Authority; the existing works, built in the 1930's, will be demolished. The new facilities, will serve a population of 47,500, and may be expanded to serve twice that number of people. On the basis of these tests, a double filtration system has been manufactured. This includes three 14/16 inch variable speed drive centrifugal pumps, three 14/16 inch main feed pumps, two 4-inch vortex type grit pumps, as well as screening disintegrators, screw pumps, screens, grit air blowers, and a standby generator.

*Laboratory tests, *Analytical techniques, *Models, Sewage treatment, Treatment facilities, Filtration, Screening, Pumps, Equipment

*Sumps

E140
ADIGE AND PO: CHEMICAL ANALYSES AND VARIOUS WATER EXAMINATIONS CARRIED OUT AT POLESINE IN 1974 (ADIGE E PO: ANALISE CHIMICHE E INDAGINE VARIE SULLE ACQUE EFFECTTUATS IN POLESINE DURANTE L'ANNO 1974),

Chioffi, V., Magon, G., Milan, A., and Stefani, B.

Inquinamento, Vol. 17, No. 6, p 12-18, June, 1975. 2 tab, 19 ref.

Studies were made of the water quality of the lower Po and Adige rivers in Italy. From a point at each river, samples were taken at time intervals extending over a year. Records were made of river height, and tests were made to determine oxygen parameters, phenols, electrical conductivity, ammonium and other N compounds, total phosphates, Cr, Pb, Cu and Zn. Findings were tabulated; pertinent topographical features are discussed, as well as sewage disposal practices and treatment methods for drinking water. Although recently there have not been major problems, there are still emergency situations in which the organoleptic characteristics of drinking water have been affected. The use of chlorine dioxide instead of Cl gas is recommended for the prechlorination stage of purification, and ferric chloride is suggested as a replacement for ferrous sulfate in coagulation. The city of Verona is still dumping raw sewage into the Adige, and it was suggested that many industries could improve their effluent treatment before releasing them into these rivers.

*Rivers, *Chemical analysis, *Sampling, Sewage disposal, Water pollution sources, Water pollution effects, Pollutant identification, Potable water, Chlorination

Po River (Italy), Adige River (Italy)

E141
SEWAGE DISPOSAL PLANT WITH AUTOMATIC CONTROL SYSTEM,

Hokushin News, Vol. 18, No. 1, p 4-12, May, 1975. 10 fig, 5 tab.

A general discussion was presented on a control system for waste water treatment. Control of inflow waste water was done by an electromagnetic flow meter and a P-B flume was used for outflow water. Sludge at the bottom of the initial sedimentation basin was removed periodically, particularly when it reached a high concentration (1-1.5%). An ultra-sonic damping device was used to give signals to stop the removal when the sludge concentration was too low. The flow rate of inlet air to the aeration tank was usually proportional to the flow rate of inflow waste water and the ratio was determined by dissolved oxygen, BOD, and suspended solids. Sludge was usually digested at about 35 degrees C and the heating was accomplished by passing hot water at about 55 degrees C or by directly introducing steam. The fermentation temperature was controlled by a platinum-resistance type meter. A three-phase treatment method was applied for water treatment by using microfiltration, coagulation-precipitation, high speed filtering with sand, ozone oxidation, ion exchange, and activated carbon.

*Sewage disposal, *Waste water treatment, *Control systems, *Automation, Flow meters, Aeration, Biological treatment, Water treatment, Filtration, Chemical precipitation, Ozone, Ion exchange, Activated carbon

E142
METHODOLOGY FOR APPLICATION OF ADENOSINE TRIPHOSPHATE DETERMINATION IN WASTEWATER TREATMENT,

Levin, G. V., Schrot, J. R., and Hess, W. C.

Biospherics Incorporated, Rockville, Maryland.

Environmental Science and Technology, Vol. 9, No. 10, p 961-965, October, 1975. 6 fig, 2 tab, 14 ref.

Because the operation of an activated sludge waste water treatment plant is based on the metabolic activity of the viable organisms present in the mixed liquor, it is necessary to have a rapid and accurate method for determining the viable biomass. A method based on the bioluminescent assay of microbial adenosine triphosphate (ATP) is presented for this purpose. Boiling TRIS buffer was selected for the extraction of ATP from sludge and mixed liquor because of its simplicity of procedure and reproducibility of results. The determination of ATP, dissolved oxygen uptake rate, tyrosine, total microscopic cell count, and turbidity in pure cultures indicated the sensitivity of the method and its applicability to activated sludge process monitoring and control. ATP measurements were then performed in a 20 mgd activated sludge sewage treatment plant. ATP analysis was used to control the mixed liquor biomass through the regulation of return sludge. A test period of one month demonstrated that good plant performance was achieved by using the ATP monitoring technique, and that there is a close relationship between ATP content and the metabolic activity of the sludge. The process should improve the quality and stability of the effluent as well as reduce operating costs and effectively increase plant capacity by minimizing the return sludge pumping.

*Waste water treatment, *Sewage, *Activated sludge, *Analytical techniques, Operation, Monitoring, Treatment facilities

Adenosine triphosphate (ATP)

E143
AUTOMATED METHODS FOR ASSESSING WATER QUALITY COME OF AGE,

DuCros, M. J. F., and Salpeter, J.

Technicon Industrial Systems, Tarrytown, New York.

Environmental Science and Technology, Vol. 9, No. 10, p 929-933, 935, October, 1975. 2 fig, 5 tab, 2 ref.

Automated wet chemistry instrumentation and methodologies for use in water quality laboratories of governmental regulatory agencies and municipal and industrial facilities are discussed with particular reference to equipment available from Technicon Industrial Systems. The Technicon AutoAnalyzer II Continuous-Flow Analytical system is a modular system capable of assaying substances at rates up to 60 samples/hour. The modular design permits the analysis of liquid, solid, or gaseous samples. Detection techniques can include colorimetry, spectrophotometry, flame photometry, fluorometry, atomic absorption spectroscopy and potentiometry. The Technicon Monitor IV system utilizes the same continuous-flow concept of the AutoAnalyzer for continuous on-site measurements. Automated analytical systems enable the user to handle larger analytical workloads more economically, and with improved precision and accuracy. The 1974 edition of EPA's Manual of Methods for Chemical Analysis of Water and Wastes states that instrumental methods have been selected over manual procedures because of their improved speed, accuracy, and precision. Twelve procedures for the AutoAnalyzer II are included in the manual for laboratories with this equipment. Information on some of the typical users of automated analytical systems is presented.

*Waste water treatment, *Water quality control, *Automation, *Analytical techniques, Equipment, Laboratory tests, Water analysis, Chemical analysis, Pollutant identification

Technicon AutoAnalyzer II Continuous-Flow Analytical system

E144
ION ACTIVITY ELECTRODE METHOD YIELDS CHLORIDE ION CONCENTRATION,

Hindin, E.

Washington State University,
Pullman,
Department of Civil and Environmental Engineering.

Water and Sewage Works, Vol. 5, No. 9, p 60-62, September, 1975. 3 tab, 7 ref.

Data gathered during a study conducted in 1974 indicate that the ion specific electrode method can be used in lieu of the standard mercuric nitrate method to determine chloride ion concentration in water and in treated sewage effluents. The maximum allowable pH at which a 3.5 mg Cl/liter solution can be measured by the ion specific electrode method without appreciable error is 11.9; however, the pH of natural waters and most waste waters is less than that value. When water is very high in ionic strength, the addition of an ionic strength adjusting solution is recommended. When this precautionary step is taken a correlation coefficient of 0.94 is obtained for data gathered by the two methods. The removal of sulfide ions was also recommended when using the ion specific electrode method. The precipitation method, using cadmium ions, was found to be most efficient because it was not time consuming and requires a minimum of sample handling.

*Chlorides, *Ions, *Analytical techniques, Hydrogen ion concentration, Waste water treatment, Electrodes, Pollutant identification, Correlation analysis, Chemical precipitation

E145
CONTAMINANTS IN RAINWATER AND THEIR RELATION TO WATER QUALITY,

Frizzola, J. A., and Baier, J. H.

Department of Environmental Control, Suffolk County, New York.

Water and Sewage Works, Vol. 122, No. 9, p 94-95, September, 1975. 1 fig, 1 tab, 15 ref.

Contaminants of rainwater are shown to have an effect on groundwater quality, by analysis of data collected at 3 stations on Long Island, New York. Background concentrations of 2 mg/liter total nitrogen enter groundwater as precipitation. Thus, when comparable concentrations are found in shallow groundwater they cannot be attributed to human pollution. Average values of ammonia concentration fit in with values from previous analyses in the northeastern United States. Ammonia can act to reduce acidity in rainwater, but since pH values of 4 or 5 are common, it seems the ammonia is either removed or dominated by stronger acid reactions. Sulfur compounds, especially sulfur dioxide formed from fossil fuel combustion, were found to be the predominant cause of acid precipitation over Long Island. Chloride/sodium ratios were less than the expected seawater values, perhaps as a result of the composite collection method. It is suggested that the term total acid effect (TAE) be used when discussing the composite sample and that scavenging acid effect (SAE) to be used to refer to pH obtained directly from natural precipitation. In this study, all ion concentrations in precipitation were reported higher at urban than at rural stations.

*Water quality, *Groundwater, Precipitation (atmospheric), Ions, Hydrogen ion concentration, Ammonia, Chlorides, Sulfur compounds

*Groundwater contamination, Total acid effect (TAE), Scavenging acid effect (SAE)

E146
CONTAMINATION OF THE DANUBE IN BRATISLAVA BY SEWAGE 2ND COMMUNICATION (DIE SALMONELLA-VERUNREINIGUNG DER DONAU DURCH ABWASSER IN BRATISLAVA 2. MITTEILUNG),

Kadlecova, O.

Zentralblatt fuer Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, Vol. 130, No. 2, p 144-150, 1975. 4 tab, 18 ref.

Samples were taken once per month for a one-year period to determine the occurrence of Salmonella in the main sewer of the city of Bratislava and in the Danube river 50, 100, and 200 meters below its outfall. The presence of Salmonella was analyzed in the 0.1, 1, 10, 50, 100, and 200 ml depths. In the 0.1 ml and one ml samples of the Danube water at all three distances below the outfall of sewage, Salmonella was detected. There were no seasonal differences found in the occurrence of pathogenic bacteria. Several tables illustrate the 623 strains of Salmonella that were isolated. These belonged to 6 serological groups, including 34 sero- and lysotypes. The most frequent types found were S. paratyphi B, S. bareilly, S. typhi-murium, and S. anatum. The frequency of occurrence of Salmonella in the water samples was compared with their occurrence in humans and animals in the Bratislava area, and significantly more serological types were found in the water samples.

*Analytical techniques, *Rivers, *Waste disposal, *Sewerage, *Pathogenic bacteria, *Salmonella, Sewers, Public health, Water pollution sources, Pollutant identification

Bratislava, Danube River

E147
DETERGENT PHOSPHATE BAN YIELDS LITTLE PHOSPHORUS REDUCTION. PART I,

Etzel, J. E., and Bell, J. M.

Purdue University,
Lafayette, Indiana,
Department of Environmental Engineering.

Water and Sewage Works, Vol. 122, No. 9, p 91-93, September, 1975. 3 fig, 4 tab, 11 ref.

A 1974 study was conducted on nutrient levels in Indiana streams and indicated that a January, 1973, legislative ban on detergent phosphates had not reduced stream phosphorus levels enough to prevent the acceleration of eutrophication. When the study was made, the ban on detergent phosphates had been in effect for over 18 months. The nutrient content of the surface waters was measured relative to generally accepted growth-limiting ranges. The presence or absence of growth limitation was established by a bioassay of algal growth potential of the surface waters; the presence or absence of surplus phosphorus in filamentous algae taken from the waters was also measured. The two Indiana river systems from which samples were taken were the Wabash and White River systems. Both are influenced by significant domestic waste water discharges. Results of chemical analyses, laboratory algal bioassay, and plant extraction procedures were displayed in several tables. Because the detergent phosphate ban had not been successful in reducing the potential for algal growth, it was suggested that nutrient removal through flocculation at sewage treatment plants might be used to reduce the discharge of all nutrients.

*Nutrient removal, *Phosphates, *Detergents, *Eutrophication, Water pollution effects, Pollutant identification, Analytical techniques, Legislation, Bioassay, Indiana, Sewage treatment, Waste disposal, Rivers

Detergent phosphate ban

E148
OXYGEN TRANSFER AT HIGH SOLIDS CONCENTRATIONS,

Baker, D. R., Loehr, R. C., and Anthonisen, A. C.

Minnesota Marine Advisory Service,
Duluth.

Journal of the Environmental Engineering Division-ASCE, Vol. 101, No. EE5, p 759-774, October, 1975. 13 fig, 1 tab, 8 ref.

The design of aeration systems for agricultural, industrial, and municipal wastes requires the knowledge of the capability of an aeration device to transfer oxygen to the waste water. Because factors affecting the capability are related to the characteristics of the waste water being aerated, this investigation was conducted to determine how the characteristics of the mixed liquor affected the oxygen transfer capacity of the aerator. Variations in oxygen demand that occurred under operating conditions were also evaluated. This particular study involved oxygen transfer and uptake relationships of waste waters at the solids concentrations found in animal waste treatment facilities. After 13 months of study, the changes in solids concentration and temperature and their effects on oxygen uptake and transfer rate in the mixed liquor were evaluated. Relationships were also found between viscosity, total solids, and alpha. It was found that oxygen uptake rates were not influenced by temperature or total solids concentration variations. Alpha was seen to decrease as the solids concentration increased above 2% and as viscosity increased. Alpha was not affected by temperature variations. The viscosity of the mixed liquor increased with an increase in solids concentration, and the effect of solids on oxygen transfer may be related to viscosity. The appropriate parameters were found for design of an aeration system treating these particular wastes. For cases when solids concentration is greater, a larger dissolved oxygen residual is needed, or a higher nitrification degree is required, the rotor should be designed for a greater oxygen transfer capacity.

*Aeration, *Design criteria, *Oxygen, *Waste water treatment, Biological treatment, Oxygen demand, Nitrification, Municipal wastes, Industrial wastes, Temperature

E149
OXYGEN TRANSFER IN FERMENTATION,

Tsao, G. T., and Lee, D. D.

Iowa State University, Ames,
Department of Chemical Engineering.

AIChE Journal, Vol. 21, No. 5, p 979-985, September, 1975. 7 fig.

An experimental investigation of interfacial resistance to oxygen transfer in biological processes was made, using an oxygen sensing microprobe. This instrument is an inert material coated long needle with an exposed sensing tip about 2 microns long and one micron wide, which can detect the local oxygen concentration and send signals to a picoammeter for readout and recording. The oxygen sensing microprobe was used in contaminated water to detect the existence of two transferring zones near a surfactant laden surface (the stagnant film zone and the penetrable zone) and to measure the frequency of surface renewal in clean water. A linear relationship was found between the square root of the renewal rate, 0.5, and the interfacial mass transfer coefficient, K sub L, which was predicted by the Danckwerts theory. Further work with the microprobe was recommended to allow direct experimental determination of the concentration profile of a transferring solute at a gas-liquid interface, and to provide information for further refinement of existing gas-liquid mass transfer theories. A clear understanding of the relationships involved in interfacial resistance to oxygen transfer is important because the rate of biological processes in aerobic fermentation and waste water treatment may be limited by them.

*Analytical techniques, *Waste water treatment, *Mass transfer, *Oxygen, Air-water interfaces, Surfactants, Fermentation, Aerobic conditions, Pollutant identification

*Oxygen sensing microprobe, Oxygen transfer, Danckwerts theory

E150
LANDSAT MEASURES OF WATER CLARITY,

Brooks, D. J.

General Electric Company, Beltsville, Maryland.

Photogrammetric Engineering and Remote Sensing, Vol. 41, No. 10, p 1269-1272, October, 1975. 2 fig, 9 ref.

LANDSAT reflectance data are compared with in situ transmittance data as a measure of water clarity. Gunston Cove, Virginia, which empties into the Potomac River, was the area chosen for study because: it has an obvious horizontal seston/reflectivity gradient; two streams emptying into the cove and the river provide a continuous contribution of suspended solids; and currents effectively keep materials in suspension. Data were collected during two different times, one at ebb tide and the other during flood tide. In situ measurements were taken at 16 different stations in a straight line approaching the Potomac River. Measurements were taken over four discrete spectral intervals: 0.5 to 0.6 microns, 0.6 to 0.7 microns, 0.7 to 0.8 microns, and 0.8 to 1.1 microns, and at a depth of one-half meter with a 10 cm pathlength. LANDSAT reflectance measurements were taken about two hours after the transmittance data were collected. Results showed that during ebb tide transmittance decreased and reflectance increased on approaching the river, while during flood tide transmittance increased and reflectance decreased. Increasing turbidity presents an increasing reflective surface to incident solar radiation, thus making the inverse correlation logical. Although more testing is required under different conditions and over larger areas before correlation between the two types of measurements can be proven, data collected so far indicate that LANDSAT reflectance measurements can be used to complement in situ transmittance measurements.

*Seston, *Transmissivity, *Reflectance, *Water circulation, *Turbidity, Tides, Suspended solids, Currents (water), Satellites (artificial), Monitoring, Pollutant identification

Gunston Cove (Va), LANDSAT, Water clarity, Spectral measurements, Potomac River

E151
METAL CONCENTRATIONS IN THE SEWAGE, EFFLUENTS, AND SLUDGES OF SOME SOUTHERN ONTARIO WASTEWATER TREATMENT PLANTS,

Oliver, B. G., and Cosgrove, E. G.

Canada Center for Inland Waters, Burlington, Ontario,
Water and Wastewater Treatment Research Section.

Environmental Letters, Vol. 9, No. 1, p 75-90, 1975. 4 tab, 17 ref.

Removal efficiencies by biological treatment of metals in raw sewage, effluents and sludges are discussed in terms of the effects on receiving waters and agricultural lands. Samples were collected at treatment plants and dissolved in acid and analyzed spectroscopically in the laboratory. The types of treatment plants studied were the conventional activated sludge system, the extended aeration system and the trickling filter system. Studies showed that the highest metallic content came from industrial waste waters, and in many cases certain metals could be traced to specific plants. Metal removal efficiencies for activated sludge plants were high except for some metals such as bismuth, nickel and strontium. This was due to the fact that most metals come out of solution when mixed with domestic waste waters, with the exception of these three. An extended aeration system showed about the same metal removal efficiency as the activated sludge plants, but the trickling filter system was slightly less efficient. The metals removed by the sewage treatment processes are heavily concentrated in the sludge. Anaerobic digestion under high temperatures reduces the volume and increases the metallic concentration. When the sludge is returned to the land there could be a detrimental effect on crop growth over a period of years. Improved guidelines must be developed before land application of sewage sludge can become an acceptable practice.

*Effluents, *Sewage, *Sludge disposal, *Waste water treatment, *Metals, *Treatment facilities, Trickling filters, Aeration, Pollutant identification, Sludge digestion, Anaerobic digestion, Sewage sludge, Sewage treatment, Land, Activated sludge, Sewage effluents, Spectroscopy, Chemical analysis, Biological treatment, Water pollution sources, Domestic wastes, Industrial wastes, Water pollution

Removal efficiencies, Metal concentrations, Land treatment

E152
A SURVEY OF THE HEAVY METAL AND INORGANIC CONTENT OF SEWAGE SLUDGES,

Williams, R. O.

University College, Cardiff, Great Britain,
Department of Mineral Exploitation.

Water Pollution Control, Vol. 74, No. 5, p 607-608, 1975. 6 tab, 2 ref.

A survey was made of 182 sewage treatment plants in England and Wales to determine the inorganic and heavy metal content of sewage sludges prior to their disposal. Plants were categorized as rural, urban, or industrial according to their known industrial waste water intake and contributing populations. The metal content of these sludges was determined by wet chemical methods, using atomic absorption spectrophotometry after destruction of the organic material. Results of inorganic contents of all the sludge samples were summarized in several tables. Metal concentrations for copper, zinc, lead, chromium, and nickel were shown. While the recommended maximum concentration of zinc equivalent in a batch of sewage sludge that can safely be allowed at an application rate of 12.5 ton DS/ha is 0.75%, 33 of the works sampled had sludges with zinc levels exceeding 0.755%.

*Sewage treatment, *Heavy metals, *Metals, *Sludge, *Treatment facilities, Waste water treatment, Waste disposal, Analytical techniques, Zinc, Copper, Lead, Chromium, Nickel, Spectrophotometry, Sampling, Pollutant identification

Sludge analysis

E153
STUDY OF COAGULATION OF WATER BY FLUOROMETRY (ETUDE DE LA COAGULATION DES EAUX PAR FLUOROMETRIE),

Serodes, J-B., and Soucy, A.

Universite Laval, Quebec, Canada,
Department de Genie Civil.

Revue Canadienne de Genie Civil, Vol. 2, No. 3, p 253-261, September, 1975.

A fluorometric method has been used to determine residual aluminum salts used as coagulants in water treatment. With this method, the influence of such factors as temperature on the hydrolysis of these salts may be evaluated. It was found that the yield of hydrolysis was lessened by low temperatures and that aluminum ion is more sensitive than aluminate ion. The method described is suggested for detecting problems in the operation of water treatment plants.

*Water treatment, *Analytical techniques, *Fluorometry, Treatment facilities, Coagulation, Aluminum, Ions, Hydrolysis, Temperature

Coagulants, Aluminate ion, Aluminum ion

E154
MONITORING LAB GIVES CITY THE JUMP ON SAFE DRINKING WATER REGULATIONS,

Duke, K. D.

Inglewood, California,
Water Department.

The American City and County, Vol. 90, No. 10, p 70-71, October, 1975.

The city of Inglewood, California with a population of 90,000, has developed a complete, well-equipped water quality monitoring laboratory. Tests are being conducted on heavy metals, trace pollutants, physical parameters, and bacteria. The laboratory personnel include a full-time chemist, a paid student, and a student being trained under the federal CETA program. A water service inspector also conducts field checking for cross-connections. The capital costs for the laboratory were about $44,000, including casework and equipment purchased over a five year period. For fiscal year 1975-1976, the approved budget was $67,000. The city relies on some ground water sources but mainly on imported water for the Metropolitan Water District of Southern California (MWD). Because of the danger of an earthquake, the community has passed a bond issue to improve its own water system by building new water lines and storage facilities as well as a new water treatment plant. The treatment plant is planned to begin operation in January 1977. The laboratory will play a major role in monitoring the processes involved with the facility. Additionally, when new drinking water regulations come into effect, Inglewood will be responsible for its own water quality and will continue monitoring its wells and treatment facilities.

*Monitoring, *Water quality, *Laboratory tests, *Water treatment, Treatment facilities, Heavy metals, Pollutant identification, Capital costs, Cities, Legislation, Equipment, Personnel

E155
LABORATORY STUDIES CONCERNING REMOBILIZATION OF PHOSPHATE FROM IRON PHOSPHATE BY COMPLEX AND PRECIPITATION REACTIONS (LABORUNTERSUCHUNGEN UEBER DIE REMOBILISIERUNG VON PHOSPHAT AUS EISENPHOSPHATE DURCH KOMPLEX-UND FAELLUNGSREAKTIONEN),

Wagner, R.

Vom Wasser, Vol. 44, p 131-172, 1975. 25 fig, 3 tab, 35 ref.

Laboratory tests were conducted on the remobilization of phosphate from iron phosphate by complex and precipitation reactions. The possibility of phosphate fixation in aerobic and anaerobic environments by iron compounds was investigated. The preparation of precipitated iron phosphate compound, used for the remobilization tests, was described. In aerobic conditions, strong chelating agents, such as EDTA and NTA, were the most effective. Among the hydroxy carboxylic acids, only citric acid had a significant effect. In the presence of calcium ions, the remobilization power of amino polycarboxylic acids was considerably diminished. Under anaerobic conditions, the release of phosphate was controlled by the amount of sulfide ions present if sequestering agents are excluded. Calcium ions also counteracted the remobilization of phosphate from ferrous phosphate by sulfide ions.

*Phosphates, *Laboratory tests, *Aerobic conditions, *Anaerobic conditions, Chemical precipitation, Chelation, Pollutant identification, Analytical techniques

Remobilization, Iron phosphate

E156
WHEN TO USE CONTINUOUS FILTRATION HARDWARE,

Emmett, R. C., and Silverblatt, C. E.

Envirotech Corporation, Salt Lake City, Utah,
EIMCO BSP Division.

Filtration and Separation, Vol. 12, No. 5, p 577-578, 580-581, September/October, 1975. 1 tab, 5 ref.

An analysis was made of the many types of continuous filtration hardware available to the potential user. Choice of filter must be made on the basis of the types of slurries to be handled, factors considered in a continuous flowsheet, and certain economic limitations. The major properties of a feed slurry to be identified and evaluated are suspended solids concentration, particle size distribution, system composition, liquid viscosity, liquid volatility, degree of liquid saturation, temperature, special properties of solids or liquid, required materials of construction, and feed rate. Once these are determined, the true requirements of a filter station are found by defining the minimum tolerable performances and the peak (desired) performances of filtrate clarity, degree of washing and filter cake liquid content. Other facets of filtration operation to be considered include cake moisture, end use of solids, capital limitations, total process flowsheet, product value and in-process inventory, chemical conditioning, and pre-treatment of slurry. Almost any size continuous filter station requires a minimum investment of $20,000. Thus, if capital is severely limited and feed slurry rate is relatively low, a batch unit, rather than continuous filtration equipment may be chosen. If batch and/or continuous filtration equipment is feasible, the final decision should be governed by economics, including process reliability in the economic evaluation. A summary is provided in tabular form of some of the major factors to be considered in selecting equipment. Comments are provided relative to the applicability of continuous or batch pressure filtration equipment.

*Filtration, *Equipment, *Filters, *Economics, Flow, Waste water treatment

E157
EPA POLICY ON THE ELIGIBILITY OF LAND ACQUISITION COSTS FOR LAND TREATMENT PROCESSES,

Rhett, J. T.

Program Guidance Memorandum No. 49, July 18, 1975. 2 p.

This memorandum provides guidelines for interpreting the EPA construction grant regulations, relative to the eligibility of the cost of land that will be an integral part of the land treatment process. The cost of this land in a system for land treatment of liquid effluents is eligible for Federal grant assistance. Land treatment processes include overland flow, rapid infiltration/percolation, and crop irrigation. Effluents may be applied to the land by spray irrigation, flood irrigation or ridge and furrow irrigation. The land treatment system must not have a commonly used outlet or discharge point prior to land treatment. Other eligible costs are the cost of land for irregularities in spray patterns, reasonable buffering, berms, dikes, and similar uses. Land costs are not eligible for assistance when the land is used for sites for the placement of buildings, equipment, interceptors, or sewage collection systems or for evaporation ponds, waste stabilization lagoons, equalization ponds, or temporary storage ponds. To apply for assistance, the facility plan for any land treatment system must include a cost-effectiveness analysis of alternative land treatment sites, as well as alternative technologies.

*Construction costs, *Waste disposal, *Waste water treatment, Irrigation, Effluents, Treatment facilities, Sewage disposal, Overland flow

Construction funds, Construction grant assistance, Land treatment, Land costs, EPA construction grant regulations

E158
COSTS OF WASTEWATER TREATMENT BY LAND APPLICATION,

Pound, C. E., Crites, R. W., and Griffes, D. A.

Technical Report EPA-430/9-75-003. June, 1975. 156 p, 41 fig, 11 tab, 61 ref, 7 append.

This report will aid planners and engineers in evaluating the monetary costs and benefits of land treatment and application systems for municipal waste water effluents so that cost effectiveness analyses may be performed. Cost information is presented for two stages of planning—preliminary cost screening and detailed cost estimates. Cost categories include land, preapplication treatment, transmission, storage, land application, and recovery of renovated water. In the first stage (preliminary screening costs), curves are presented relating capital, amortized, and operation and maintenance costs to average flow rates of between 0.1 and 100 mgd. Cost calculation procedures are also outlined. For the detailed planning costs, curves, tables, and data are presented for 33 individual cost components related to either flow rate or field area. For items of capital, total construction costs are given. Operation and maintenance costs are presented in terms of labor, materials, and power.

*Costs, *Land management, *Waste disposal, *Flow rates, Water reuse, Planning, Effluents, Capital costs, Operating costs

Cost effectiveness, Land application, Land treatment

E159
CURRENT DPD METHODS FOR THE DETERMINATION OF RESIDUAL HALOGEN COMPOUNDS AND OZONE IN WATER (AKTUALNE METODY DPD DLA ZWYAZKOW CHLOROWEOW I OZONU POZOSTALYCH W WODZIE),

Palin, A. T.

Roczniki Panstwowego Zakladu Higieny, Vol. 26, No. 4, p 470, 1975.

The DPD (N,N-diethyl-p-phenylene-diamine) method of determining the concentration of residual effective chlorine in water has been modified. It permits determination of residual effective chlorine in the presence of CO2 chlorites, bromine, and ozone. The author recently has included glycine (C2H5NO2) which immediately forms chloramine acetate with free chlorine, but does not bind ClO2. In the presence of KI, monochloracetic acid reacts with DPD. For the titration of iron content, ferro-ammonium sulfate of a known titer added to the sample can activate the chlorites developing as a result of ClO2 reduction. This process interferes with the establishment of the first end point of titration. In order to prevent this, 0.2 g of disodium edetate is added. For the determination of bromine and broamine in the presence of free chlorine, glycine must be added at the beginning of the analytical procedure in order to bind free chlorine. For ozone determination, excess KI, before or simultaneously with DPD, is added. The addition of glycine during the first phase of the analysis, however, leads to immediate decomposition of ozone which permits determination of effective chlorine after successively adding Ki and DPD to the solution. In the summary, the manner in which special determinations are carried out and what reagents have been used were indicated.

*Ozone, *Halogens, *Analytical techniques, Chlorine, Water analysis, Pollutant identification

DPD method

E160
QUALITY CONTROL STARTS AT THE PIPE,

Keeffer, W. J.

U. S. Environmental Protection Agency,
Kansas City, Missouri.

The American City and County, Vol. 90, No. 10, p 74-75, October, 1975.

Region VII of the Environmental Protection Agency has evaluated the need for better effluent sampling techniques, with a greater frequency. As a result of the Water Pollution Control Act Amendments, there has been an increased demand for waste water chemistry data on point source discharges. Present sampling technology uses flow proportional compositing techniques, and the variations in sampler performance and manual sampling techniques mask actual changes in the characteristics of the waste water. Possible sources of error in manual flow compositing or discrete grab samples include: not shaking the discrete sample before compositing, miscalculating correct sample volumes when determining discharge rates from exponential functions based on hydraulic head measurements, and misreading of graduated cylinders. For industrial waste sampling, it is recommended that two compositors (one with discrete sample jars on an hourly cycle, the other taking aliquots at more frequent intervals) be used. Under even ideal circumstances, flow rates cannot be measured more precisely than ± 10%. Also, the individuals responsible for surveys and sample collection can intentionally or unintentionally manipulate apparent waste water chemistry characteristics. There is a need for more trained and supervised personnel to collect samples and to perform analyses. Adequate monitoring and tight control on sampling techniques, laboratory procedures and equipment, and data interpretation is urged.

*Monitoring, *Water quality control, *Pollutant identification, *Analytical techniques, Laboratory tests, Sampling, Industrial wastes, Waste water treatment, Chemical analysis, Water analysis, Personnel, Water pollution sources

E161
VELOCITY GRADIENT CALIBRATION OF JAR-TEST EQUIPMENT,

Lai, R. J., Hudson, H. E., and Singley, J. E.

Environmental Sciences and Engineering, Incorporated,
Gainsville, Florida.

American Water Works Association Journal, Vol. 67, No. 10, p 553-557, October, 1975.
9 fig, 2 tab, 11 ref.

The jar-test procedure is widely used for calibrating and simulating water pre-treatment processes in the laboratory, but no standard for this procedure exists. The mixing intensities, expressed as the mean velocity gradient, G, of four jar-test configurations were determined throughout the applicable speed range. The fluid condition in plant mixing and flocculation basins is always turbulent and at common jar-test speeds, laminar flow conditions may occur. Minimum threshold speeds required to produce turbulence were determined. Stokes' theory relates the velocity gradient to the power dissipation function, which can be determined by calculating the torque on the rotor blades. The turbulent gross drag coefficient and the viscous gross drag coefficient can be calculated from G and the speed of the rotors. An alternate approach that was developed used the Reynolds number and the Power number. The force on and the speed of revolution of the rotors were measured in the laboratory. Values for G, the two drag coefficients, the Reynolds number and the Power number were then calculated. Results from the four configurations studied showed that G values depend on the projected areas of the impellers and not on their shape. Variations of the distance of the impellers from the beaker bottoms did not change the energy input. The energy input did increase with the addition of baffles, but it was the same regardless of baffle size or geometry with a given impeller. The minimum threshold speed for turbulence was 100 rpm for unbaffled systems and 40-50 rpm with baffled systems.

*Velocity, *Calibrations, *Testing procedures, *Equipment, *Analytical techniques, Mixing, Pre-treatment (water), Turbulence, Stokes law, Impellers, Laboratory tests, Laboratory equipment, Fluid mechanics

*Jar-test equipment, *Velocity gradient, Threshold speeds, Drag coefficients

E162
AUTOMATIC SEWER SAMPLING SYSTEM, MONITORS FOR SPILLS,

Calluzzo, J. F.

Union Carbide Corporation, Chicago, Illinois.

Pollution Engineering, Vol. 7, No. 9, p 73, September, 1975. 1 fig.

An automatic sampling and monitoring system is described which can be installed in plant sewers to detect any accidental spills or abnormal discharges in a production plant. The monitoring system can be used to monitor sewers which carry storm water, surface run-off water, or cooling water. The pH, conductivity, and total organic carbon are reported for each stream. Specially designed floats are suspended in the flowing streams of the sewers which draw off a uniform continuous sample. The sample is pumped by self-priming pumps into flow-through type pH and conductivity sensors and into a total carbon analyzer. The flow-through sensors for pH and conductivity are cleaned periodically by ultrasonic cleaners. The water sample to the carbon analyzer is filtered; the filter is cleaned as needed. High and low alarms are provided for pH. High alarms are provided for conductivity and total carbon. When an alarm is activated, a grab sample of the abnormal stream is taken immediately. The sample is then analyzed to determine the specific pollutant present. The system permits closer control of unplanned spills and discharges.

*Water quality control, *Water pollution sources, *Industrial wastes, *Spills, Monitoring equipment

E163
DETERMINATION OF DISSOLVED GASES IN WATER BY DIFFUSION AND GAS CHROMATOGRAPHIC TECHNIQUES,

Kollig, H. P., Falco, J. W., and Stancil, F. E., Jr.

Environmental Protection Agency,
Athens, Georgia,
Southeast Environmental Research Laboratory.

Environmental Science and Technology, Vol. 9, No. 10, p 957-960, October, 1975.
5 fig, 1 tab, 12 ref.

A newly developed method for the simultaneous determination of oxygen, nitrogen, and carbon dioxide in water is reported. The technique consists of membrane diffusion and subsequent analysis by gas chromatography. Gases diffuse from the water through a plastic membrane. Helium gas carries the diffused gases to a dual column gas chromatographic gas analyzer. This system has a sensitivity of 5-10 micrograms/liter of dissolved gas in water. Gas probes are calibrated in a water bath through which analyzed air containing a predetermined amount of carbon dioxide has been passed. These probes may be used in both static and dynamic waters. When used in static water, a stirrer must be mounted near the probe. By knowing convective flow around the membrane, and by application of corrective factors for turbulence and temperature, a high degree of accuracy is achievable.

*Water analysis, *Pollutant identification, *Oxygen, *Nitrogen, *Carbon dioxide, Membrane processes, Gas chromatography, Analytical techniques, Diffusion

E164
PERFORMANCE OF AUTOMATIC WASTEWATER COMPOSITORS,

Harris, D. J., and Keefer, W. J.

Environmental Protection Agency, Region VII,
Kansas City, Missouri,
Surveillance and Analysis Division.

In: Proceedings of the 29th Industrial Waste Conference, May 7-9, 1974, Purdue University, Lafayette, Indiana, p 213-222. 7 tab, 1 ref.

Discrepancies in water quality data have been noted which appeared to result from variations in automatic waste water sampling equipment performance. Four studies were conducted to compare the water chemistry data of samples collected concurrently with various makes and models of commercially available samplers. Analysis was performed on samples from the Richards-Gebaur AFB, the Thersea Street Sewage Treatment Plant in Lincoln, Nebraska, the Ashland, Nebraska, Sewage Treatment Plant, and the KAW Point Sewage Treatment Plant in Kansas City, Kansas. Each comparison indicated significant raw waste data discrepancies resulting from differences in performance of sampling equipment or manual techniques. The implication is that waste water chemistry characteristics and facility removal effectiveness can be manipulated intentionally or unintentionally by selection of sampling equipment. High-vacuum samplers produced more representative samples and should be used on raw municipal waste waters or wastes with significant levels of heavy suspended material. Current sampling methodologies and equipment must be refined to improve data reproducibility and accuracy.

*Sampling, *Data collections, *Water quality, *Equipment, *Automation, *Waste water treatment, Treatment facilities, Monitoring, Analytical techniques, Chemical analysis, Water analysis, Sewage treatment, Pollutant identification, Measurement

Water quality samplers, Water quality data

E165
FORMATION OF ORGANOCHLORINE COMPOUNDS FROM THE CHLORINATION OF A MUNICIPAL SECONDARY EFFLUENT,

Glaze, W. H., and Henderson, J. E., IV

North Texas State University,
Denton,
Institute for Environmental Studies.

Journal Water Pollution Control Federation, Vol. 47, No. 10, p 2511-2515, October, 1975. 3 fig, 1 tab, 7 ref.

The use of "superchlorination", or using a much larger chlorine dosage than usually required for specialty applications, of waste waters or waste products was found to yield significant quantities of new chlorinated organics. There has been a great deal of concern about the possible deleterious effects of such compounds on receiving streams and on chronic health effects should such compounds enter potable water supplies. In a laboratory investigation, grab samples from a sewage treatment plant were collected and treated with a chlorine dose of 1500 mg/liter. Chlorinated and control waste water extracts were analyzed by gas chromatography. Most of the compounds identified were aromatic derivatives. A qualitative-quantitative analysis of the chlorinated organics found in the waste water effluent was presented in a table. Concentrations of the compounds (in the microgram per liter range) agreed with previous research in this area. Further work is in progress to determine if any of the chlorinated acetone derivatives found might be precursors of chloroform. Other research is underway, using micro-coulometric methods to determine the total organic-bound chlorine content in chlorinated secondary effluents.

*Chlorination, *Organic compounds, *Waste water treatment, *Effluents, Sewage treatment, Analytical techniques, Water analysis, Laboratory tests, Public health, Pollutant identification, Gas chromatography

Superchlorination, Organochlorine compounds

E166
ANALYTICAL METHODS FOR ORGANIC COMPOUNDS IN SEWAGE EFFLUENTS,

Notes on Water Pollution, No. 70, September, 1975. 1 fig, 4 tab, 32 ref.

Certain quantities of organic matter are resistant to biodegradation due to conventional treatment processes. Broad characterizations of sewage effluents are useful in pointing toward the type of detailed analysis that is necessary. Sensitive analytical techniques for detection of organic matter in effluents are discussed. The organic constituents of an effluent must first be concentrated into a small volume so that they fall within the limits of sensitivity of the detection apparatus. Newer methods being used include head-space analysis, liquid-liquid extraction, freeze drying followed by liquid-solid extraction, vacuum evaporation, steam distillation, foam concentration and concentration by synthetic resins. Two methods of separation are gas-liquid chromatography (GLC) and high-pressure liquid chromatography (HPLC). GLC is useful for separating volatile substances, which make up 30 to 40% of the organic carbon present in sewage effluent. Detectors developed for GLC analysis include electron-capture detectors, thermionic detectors and microwave-plasma detectors. HPLC can be used for the remaining 60 to 70% of the organic matter that is non-volatile. However, it has not reached the same stage of advanced development as has GLC and there are no comparable detectors. Two characterization techniques used are infrared (IR) spectroscopy and mass spectroscopy (MS). Both of these techniques can be coupled with GLC systems, providing rapid accumulation of vast quantities of spectral data. GLC and MS can also be combined with computer systems as can other instrumental analytic methods.

*Analytical techniques, *Organic compounds, *Sewage effluents, Sewage, Effluents, Pollutant identification, Sewage treatment, Waste water treatment, Gas chromatography, Mass spectrometry, Infrared radiation, Volatility, Computers, Freeze drying, Vacuum drying, Resins, Instrumentation

Gas-liquid chromatography, High-pressure liquid chromatography, Infrared spectroscopy, Thermionic detectors, Microwave-plasma detectors, Electron capture detectors, Head-space analysis, Liquid-liquid extraction, Steam distillation, Foam concentration

E167
TRACE ELEMENTS IN BIOLOGICAL WASTE TREATMENT WITH SPECIFIC REFERENCE TO THE ACTIVATED SLUDGE PROCESS,

Wood, D. K., and Tchobanoglous, G.

California University, Davis.

In: Proceedings of the 29th Industrial Waste Conference, May 7-9, 1974, Part 2, Lafayette, Indiana, Purdue University, p 648-661. 4 fig, 6 tab, 21 ref.

The significance of trace elements in biological waste treatment is discussed, with specific reference to the activated sludge process. The role of trace elements in waste water is reviewed. They are required for the growth and metabolism of microorganisms. Microbial growth can be controlled by controlling their concentrations. It has not been possible to establish the specific trace element requirements of microbial populations in waste water treatment processes. Trace elements found in waste water depend on their source and the removal mechanisms in the waste stream. The most significant source is domestic water supply. The requirements of municipal ordinances limit the contributions of domestic additions and industrial discharges. Other sources include surface runoff and sewer infiltration. Removal mechanisms include adsorption, hydroxide precipitation, hydrogen sulfide precipitation and chelation. In the activated sludge process it was found that the following requirements of trace elements must be met: trace elements needed to activate enzymes responsible for degrading the waste must be present; those responsible for growth and metabolism must be present; their concentrations must be in balance with that of the waste; and, the concentration must be high enough for cells to concentrate and use them. A study conducted on the Sacramento County complete-mix activated sludge process is discussed. Results show that deficiencies of certain trace elements can be a factor in producing the proper types of bacteria essential for waste treatment. These elements must be considered in designing new treatment systems.

*Trace elements, *Biological treatment, *Waste treatment, *Activated sludge, Waste water treatment, Microorganisms, Legislation, Domestic wastes, Industrial wastes, Domestic water, Enzymes, Growth rates, Metabolism, Bacteria, Treatment facilities, Surface runoff, Adsorption, Chelation, Chemical precipitation

Complete-mix activated sludge process, Sacramento County (Calif), Municipal ordinances, Sewer infiltration

E168
OXYGEN DEMAND PARAMETERS: CORRELATION OF BOD5 WITH COD,

Janardan, K. G., and Schaeffer, D.

Sangamon State University, Springfield, Illinois,
Math Systems Program.

Water and Sewage Works, Vol. 122, No. 10, p 62-65, October, 1975. 8 fig, 3 tab, 11 ref.

Examinations of stream and effluent BOD5 and COD measurements have indicated that monitoring for COD can replace BOD measurements for routine screening. It is necessary to test for BOD5 only if the sample COD exceeds a specified maximum. Statistical analyses were performed on 113 stream samples and 713 effluent samples gathered in Illinois Environmental Protection Agency laboratories from January 1971 to December 1972. A statistical correlation was established between COD and BOD5. The regression coefficients are not a technique for calculating BOD5 values from COD data. The establishment of the correlation permits the substitution for BOD5 by COD after corresponding control limits for COD are determined at a chosen level of probability. If the COD value exceeds the chosen limit, then a BOD5 test should be performed because the legal limits are based on BOD5.

*Biochemical oxygen demand, *Chemical oxygen demand, *Statistics, Analytical techniques, Laboratory tests, Correlation analysis, Statistical methods

Correlation coefficient

E169
DETERMINATION OF AMMONIA-, NITRATE-, AND ORGANIC NITROGEN IN WATER AND WASTE WATER WITH AN AMMONIA GAS-SENSING ELECTRODE,

McKenzie, L. R., and Young, P. N. W.

Invercargill, New Zealand,
Southland Regional Water Board.

The Analyst, Vol. 100, No. 1194, p 620-628, September, 1975. 7 tab, 10 ref.

An Orion ammonium ion selective electrode has been used for the determination of ammonia-nitrogen, nitrate-nitrogen, and organic nitrogen in both waters and effluents. Nitrate-nitrogen could be measured as ammonia-nitrogen after reduction in acid conditions, with the use of an alkali of higher concentration than normal to achieve a pH of 12. A simple method for reducing nitrate-nitrogen to ammonia-nitrogen was employed, with nascent hydrogen produced in situ by the action of acid on Devarda's alloy. It was found that the presence of metals producing insoluble hydroxides when the alkali pH adjuster was added to the sample interferred with the permeability of the membrane and affected the response time of the electrode. However, this interference could be avoided with the use of EDTA in large amounts. By using 1.0 M EDTA as a complexing agent, the measurement of ammonia-nitrogen compounds in sea water was simplified. The ammonia electrode was also used to determine organic nitrogen in waste water and water samples. The electrode does not produce any improvements over a conventional method. However, because organic nitrogen may be determined in conjunction with ammonia- and nitrate-nitrogen in the same sample, the advantage lies in using a single measuring technique for the three types of compounds.

*Nitrogen, *Pollutant identification, *Water analysis, Ammonium compounds, Electrodes, Ion exchange, Measurement, Sampling, Organic compounds, Water pollution, Water quality, Waste water treatment

Ammonium ion selective electrode, Ammonia-nitrogen, Nitrate-nitrogen, Organic nitrogen

E170
OZONATION OF WATER: ROLE OF HYDROXYL RADICALS AS OXIDIZING INTERMEDIATES,

Hoigne, J., and Bader, H.

Swiss Federal Institute of Technology,
Duebendorf-Zuerich, Switzerland,
Institute for Water Resources and Water Pollution Control.

Science, Vol. 190, No. 4216, p 782-784, September, 1975. 3 fig, 1 tab, 8 ref.

Ozone is used as the oxidizing agent for water and waste water treatment in various countries. Extensive literature on reactions involving hydroxyl radicals may be applied to evaluate and optimize these ozonation processes. Experiments were conducted which showed that ozone reacts with substrates in water by two different pathways and that hydroxyl radicals are important oxidative intermediates formed in the decomposition of ozone. A reaction scheme was tested. It was demonstrated that types of oxidants involved in the reaction could be identified from the relative rates at which parts of substrates compete with each other for the oxidant. Thus, the previously recorded and present experimental data on the reactions of hydroxyl radicals may be used to describe oxidations following ozone decomposition.

*Ozone, *Water treatment, *Waste water treatment, *Model studies, Kinetics, Analytical techniques

Hydroxyl radicals

E171
STUDIES ON ANION ACTIVE SURFACTANTS. I. DETERMINATION OF ANION ACTIVE SURFACTANTS IN NATURAL AND WASTE WATERS USING CLEANUP BY XAD 2 COLUMN CHROMATOGRAPHY (In ion kaimen kasserzai ni kansuru kenkyu (Dai 1 po),

Takeshita, R., and Yoshida, H.

Eisei Kagaku, Vol. 21, No. 4, p 209-215, 1975. 1 fig, 4 tab.

Anion-active surfactants, both in natural waters and waste waters, may be determined by a reliable method. The method consists of cleanup on an Amberlite XAD2 column and determination by colorimetry using Methylene Blue. A sample may be directly passed through the column; the column is then washed with 0.05 N sodium hydroxide solution. Surfactants taken up by the resin are eluted with a mixture of acetone and aqueous ammonia. The acetone is then evaporated from the effluent and the surfactants are determined as sodium 4-(2-dodecyl)benzenesulfonate by the Methylene Blue method. Even when surfactants are contained at very low levels, they may be concentrated and measured by loading a large amount of the sample over the column. The average recovery of sodium 4-(2-dodecyl)benzenesulfonate from water fortified at levels of 50 and 100 micrograms was 100.5%.

*Surfactants, *Water analysis, *Analytical techniques, *Pollutant identification, Colorimetry, Ion exchange

Anion-active surfactants, Methylene Blue method

E172
BORON TOXICITY IN RED PINE FOLLOWING MUNICIPAL WASTE WATER IRRIGATION,

Neary, D. G., Schneider, G., and White, D. P.

Forest Research Institute, Rotorua, New Zealand.

Soil Science Society of America Proceedings, Vol. 39, No. 5, p 981-982, September-October, 1975. 1 fig, 2 tab, 10 ref.

Plants have a high nutrition absorption capacity and are susceptible to various nutrient toxicities. Minor chemical constituents in municipal wastes can cause contamination at land treatment sites. Studies have been conducted in which boron in waste water has been suspected to cause necrosis, or browning of the tips of pine needles, in the red pine tree. The effects of waste water containing concentrations of boron on red pines was studied. A number of plots were irrigated with varying amounts of waste water effluent from the Middleville, Michigan, waste water oxidation ponds. The irrigation was conducted over a period of two summers. Samples of the waste water analyzed weekly before irrigation showed low concentrations of boron. At the end of the irrigation the foliage was collected and ashed and analyzed for boron using a mass spectrograph. Humus collected in the area was analyzed in the same way. Evidence of foliar toxicity was noted in trees receiving 25, 50 and 88 mm/week of waste water despite the low concentration of boron. The effect can accumulate over a short period of time. Boron was found in even higher concentrations in the humus than in the foliage of the red pines. It was also found in high concentrations within the upper 30 cm of the soil profile. This raises questions about the feasibility of irrigating forest systems with waste water.

*Boron, *Waste water (pollution), *Waste water disposal, *Municipal wastes, *Red pine trees, Toxicity, Effluents, Nutrients, Irrigation, Foliar, Mass spectrometry, Humus, Soil profiles

Nutrient absorption capacity, Land treatment sites, Necrosis, Middleville (Mich)

E173
CHECK THAT PH!,

Cho, C.

Fisher Controls Company, Marshalltown, Iowa.

Water and Wastes Engineering, Vol. 12, No. 10, p 70-71, October, 1975. 8 fig.

Controlling pH is one of the most important operations in any waste water treatment process. However, control of alkalinity or acidity is difficult because pH is a nonlinear function of the proportions of components in a solution, and extremely high gain occurs near the neutral point. Titration curves are illustrated that show the effects of neutralizing agents on acids and bases. These curves are the basis for pH control system design and must be defined for each application. Another problem with pH control is that the process usually involves mixing large quantities causing long time constants. The lags can be minimized by using small tanks to reduce transport delays and permit good mixing. However, the tank must be sufficiently large so that hold-up is long enough to allow the reaction to be completed. If fluctuations around the desired point can be tolerated, then on-off control systems can be effective. Simple feedback loops based on specially-designed nonlinear pH controllers are satisfactory for most applications. The controllers are proportional-integral-derivative elements. If the controller is set to correspond with the steeply sloped titration curve, then the net open-loop gain of the controller and process is essentially made linear. An example of a simple continuous pH control system is schematically illustrated.

*Waste water treatment, *Neutralization, Equipment, Hydrogen ion concentration, Mixing, Acidity, Alkalinity, Acid-base equilibriums, Control systems, Control, Analytical techniques

E174
A SIMPLIFIED PHOSPHORUS ANALYSIS TECHNIQUE,

Eisenreich, S. J., Bannerman, R. T., and Armstrong, D. E.

Wisconsin University, Madison, Water Chemistry Laboratory.

Environmental Letters, Vol. 9, No. 1, p 43-53, 1975. 1 fig, 3 tab, 10 ref.

Common techniques for the determination of total phosphorus (TP) and total dissolved phosphorus (TDP) depend on a digestive or oxidative procedure followed by a type of molybdenum blue procedure. These techniques are complicated and time consuming. A simplified and more sensitive procedure has been developed to determine TP, TDP and the dissolved reactive phosphorus (DRP). The neutralization, transfer and dilution steps needed in the other procedure are eliminated. A single digestive reagent and a single mixed reagent for color formation are required. The absorbance of the resultant solution is measured at 882 nm. It is also possible to measure the absorbance at a secondary peak at 710 nm with a 30% reduction in sensitivity, if the higher wavelength is not available. This method results in a 70% decrease in analysis time, a decrease in the amount of glassware needed and a 30% increase in sensitivity. It can be applied to samples containing phosphorus in the range of 2 to 1000 micrograms P/liter and can be extended by a factor of five by using sample aliquots of as little as 5 ml. Centrifugation of samples containing large quantities of suspended matter following digestion is recommended.

*Phosphorus, *Chemical analysis, Pollutant identification, Digestion, Oxidation, Absorption, Analytical techniques

Total phosphorus, Total dissolved phosphorus, Dissolved reactive phosphorus, Molybdenum blue

E175
A MODIFIED PROCEDURE FOR THE DETERMINATION OF NITRATE IN SEDIMENTS AND SOME NATURAL WATERS,

Afghan, B. K., and Ryan, J. F.

Canada Centre for Inland Waters,
Burlington, Ontario,
Analytical Methods Research Section.

Environmental Letters, Vol. 9, No. 1, p 59-73, 1975. 3 fig, 2 tab, 12 ref.

It has been found that existing methods for determining nitrate in sediments and some natural waters do not give precise and accurate results due to the presence of sulfide and high concentrations of humic acid substances. A procedure for the removal of these substances prior to nitrate analysis by a colorimetric method is described. The sulfide in the acidic medium is first removed by copper and the humic acid-copper complexes are precipitated by neutralizing the pH of the solution. Sediment samples were collected by a Shipek bucket sampler, freeze dried to remove water, ground to fine particles and stored. The sulfide and the humic acid were removed by the successive addition of copper sulfate to precipitate the sulfide and potassium hydroxide to neutralize the solution and precipitate the copper and humic acid. Colorimetric analysis was then performed on the resulting solution to determine nitrate concentration. Samples were spiked with known amounts of nitrate to test the procedure and results were consistently near the 100% recovery level compared to low recovery levels for samples not treated. Detailed analyses, conducted to determine what substances in waste water interfered with the process and therefore had to be removed, showed that calcium, iron, manganese and sulfide ions in addition to humic acid interfered. The procedure has been tested on a wide variety of natural water samples, sediments, clays and sands.

*Nitrate, *Sediments, *Natural streams, Chemical analysis, Colorimetry, Chemical precipitation, Acidity, Pollutant identification, Waste water (pollution), Humic acids, Analytical techniques

Shipek bucket sampler

E176
ANALYSIS FOR AQUEOUS NITRATES AND NITRITES AND GASEOUS OXIDES OF NITROGEN BY ELECTRON CAPTURE GAS CHROMATOGRAPHY,

Ross, W. D., Buttler, G. W., Duffy, T. G., Rehg, W. R., and Wininger, M. T.

Monsanto Research Corporation,
Dayton, Ohio,
Dayton Laboratory.

Journal of Chromatography, Vol. 112, p 719-727, October, 1975. 3 fig, 2 tab, 7 ref.

Because of the toxicity and reactivity of nitrogen oxide gases and aqueous soluble nitrites and nitrates, analysis methods are of great concern. A gas chromatographic method of analysis based on the nitration of an aromatic compound is described. If benzene is used in combination with sulfuric acid, potassium nitrate, potassium nitrite or nitric acid as reagents, nitrobenzene will be produced. The advantages of this process are: nitrobenzene is relatively stable and can be stored before sampling; many different species of nitrogen based compounds can be analyzed using the same apparatus and almost the same analysis procedure; nitrobenzene can be detected with great sensitivity with an electron capture detector (ECD); and only very small samples are needed because of the great sensitivity. Analyses were conducted to determine the reactivity of benzene with nitrate, and the GC properties of nitrobenzene. The chromatograms were found to be relatively free of interfering peaks, indicating that the samples were of high purity. Solubility studies showed that nitrobenzene separated between two layers of benzene and sulfuric acid. This is a necessary consideration in the calibration procedures, of which three were developed. Tests performed on efficiencies of conversion showed that potassium nitrate gives the highest efficiency, nitric acid the next highest and potassium nitrite the lowest efficiency. Tests were also made to determine the concentrations of nitrates in human urine and drinking water from a city water supply.

*Nitrates, *Nitrites, *Nitrogen, *Gas chromatography, *Chemical analysis, Pollutant identification, Aromatic compounds, Nitrogen compounds, Calibrations, Solubility,

E177
THE ANALYSIS OF ORGANIC VOLATILES IN WATER BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY WITH GLASS CAPILLARY COLUMNS,

Bertsch, W., Anderson, E., Holzer, G.

Alabama University, University,
Department of Chemistry.

Journal of Chromatography, Vol. 112, p 701-718, October, 1975. 4 fig, 4 tab, 70 ref.

The increasing use of water from polluted sources for drinking purposes has made it necessary to monitor that water from all aspects. Halogenated hydrocarbons have recently been found in drinking waters. A short review of current sampling procedures and some of the options are discussed. Processes that have been applied in the past include liquid-solid adsorption, batchwise and continuous liquid-liquid extraction, freeze-drying, distillation, vacuum evaporation, gas-phase stripping and reverse electroosmosis. There are many factors present which can introduce systematic errors into these systems. The alternate method described is based on gas-phase stripping. Organic substances which partition in the gas phase are continuously removed from the water. They are concentrated and adsorbed onto a porous polymer. Separations were carried out by using highly efficient glass capillary columns. The sample is transferred into a gas chromatographic column by a process using heat desorption. The capacity of the adsorbent was determined for a number of model substances found in water. Compounds less volatile than benzene were usually retained, with some exceptions. Samples studied included both tap water and untreated waters. High incidences of halogenated hydrocarbons were found in drinking water but not in industrial or stream waters, supporting the hypothesis that they are introduced in the water treatment process. Samples from a recreational lake showed high concentrations of volatiles. Samples from industrial waters showed camphor related substances and terpene derivatives.

*Volatility, *Organic compounds, *Gas chromatography, *Mass spectrometry, Analytical techniques, Chemical analysis, Pollutant identification, Gases, Organic compounds, Potable water, Waste water (pollution), Adsorption, Aromatic compounds, Industrial wastes, Water treatment

*Gas capillary columns, Halogenated hydrocarbons, Gas-phase stripping, Desorption

E178
DETERMINATION OF TRACE ORGANICS IN MUNICIPAL SEWAGE EFFLUENTS AND NATURAL WATERS BY HIGH-RESOLUTION ION-EXCHANGE CHROMATOGRAPHY,

Pitt, W. W., Jolley, R. L., Scott, C. D.

Oak Ridge National Laboratory,
Oak Ridge, Tennessee.

Environmental Science and Technology, Vol. 9, No. 12, p 1068-1073, November, 1975.
4 fig, 3 tab, 13 ref.

The recent need for the multiple reuse of surface waters has led to an increased concern over the nature of the contaminants that may be found. Former techniques for determination have concentrated on gross organic content. High resolution anion exchange chromatography is studied for analyzing individual trace organics in natural waters. This method is useful because of its sensitivity and capability of analyzing many low molecular weight refractory organics in aqueous samples. Concentrations of many of the organic substances present in the polluted waters were below the detection limits of the chromatography technique used. Third and fourth order concentrations were required. A procedure based on low temperature vacuum evaporation was used to achieve this. The detectors used in the chromatographic technique were a dual wavelength ultraviolet photometer and a cerate oxidation system. These two used together permitted the detection of additional compounds and greater sensitivity. Each compound was identified by its elution position, its relative absorbance at the two ultraviolet wavelengths and its cerate oxidizability. Other techniques such as gas chromatography and mass spectrometry were used to corroborate the data. Effluents from primary and secondary stages of a municipal sewage treatment plant were analyzed along with samples from five natural waters. More than 150 compounds were separated from the primary stage of the treatment plant. Of these, 56 were identified. Fifty compounds were separated from secondary plants and 13 were identified. In natural waters, 16 compounds have been identified, with testing still going on. This method has found much use in studying chlorination effects.

*Chromatography, *Sewage effluents, *Trace elements, *Organic compounds, *Municipal wastes, *Natural streams, Pollutant identification, Water analysis, Chemical analysis,

E179
HEAVY METAL RELEASE BY CHLORINE OXIDATION OF SLUDGES,

Oliver, J. W., Kreye, W. C., and King, P. H.

Van Note-Harvey Associates,
Blacksburg, Virginia.

Journal Water Pollution Control Federation, Vol. 47, No. 10, p 2490-2497, October, 1975. 5 fig, 6 tab, 15 ref.

Chlorine oxidation of sludge from the treatment of combined municipal-industrial wastes was researched. Quantitative analysis was performed on heavy metal release from various sludges in a laboratory chlorine oxidation process and in a full-scale operating unit. The chlorine oxidation process is an alternative to anaerobic digestion. Results indicated that (quantitatively) the release of heavy metals from sludge is stabilized by using the chlorine oxidation method. The optimum digestion procedure for determining the heavy metal content of sludge was HNO3-HCl double digestion for six hours. The release of such metals from sludges (consisting of primary plus activated or trickling filter humus and anaerobic) was found to be a function of the final pH of the sludge after chlorine oxidation, the type of sludge oxidized, and the species of metals present in the sludge. Because the filtrate from chlorine oxidation is usually recycled to the influent of a waste water treatment plant, detrimental effects may result from the heavy metals. In addition, COD, pH, chlorides, phosphorus, and chloramines found in the filtrate should be evaluated. It was suggested that pH adjustment should be practiced following chlorine oxidation and before the final dewatering in order that the filtrate returned to the treatment plant be less harmful to the facility.

*Sludge treatment, *Municipal wastes, *Industrial wastes, *Heavy metals, *Water reuse, Recycling, Treatment facilities, Waste water treatment, Chlorination, Dewatering, Sludge digestion, Laboratory tests

Chlorination oxidation, Sludge chlorination, Filtrates, Municipal-industrial wastes

E180
V-NOTCH WEIR AIDS IN METERING TREATED EFFLUENTS,

Clontz, J. M.

J. M. Clontz Associates,
Tampa, Florida.

Water and Sewage Works, Vol. 122, No. 10, p 86-87, October, 1975. 2 fig.

V-notch weirs have been used to meter effluents from small on-site waste treatment plants in developing rural areas. In Broward County, Florida, such treatment facilities are being replaced with sewers. At present, however, many small treatment plants are located unobtrusively on private properties. In this county, polluters are liable for a civil penalty of up to $5000 per day. Thus, an accurate measure of effluent flow from the small plants is necessary. An effluent flow measuring system was developed by the American Meter Division of the Singer Company. The system provides a daily chart record of flow in gallons per hour, with indication of variations in the flow rates and a cumulative digital read-out of total effluent volume. Thus, periodic readings show total flow per day or week. The measurement is made by an open channel v-notch weir, including a recorder. Installations of the weir and recorder are illustrated. When flow rates exceed the range of the v-notch weir application, other equipment such as rectangular weirs, Parshall flumes, and Palmer-Bowlus flumes may be substituted.

*Flow measurement, *Weirs, *Effluents, *Sewage treatment, *Waste water treatment, Treatment facilities, Sewers, Equipment, Monitoring, Water pollution control, Waste treatment, Waste disposal, Pollutant identification, Rural areas

V-notch weirs

E181
COMPARISON OF THE NEW MILLIPORE HC WITH CONVENTIONAL MEMBRANE FILTERS FOR THE ENUMERATION OF FECAL COLIFORM BACTERIA,

Green, B. L., Clausen, E., and Litsky, W.

Massachusetts University, Amherst,
Department of Environmental Sciences.

Applied Microbiology, Vol. 30, No. 4, p 697-699, October, 1975. 3 tab, 2 ref.

Membrane filters currently used to determine the extent of fecal coliform pollution have a retention pore size of 0.45 micrometers and varying surface pore diameters. It has been shown that the recovery of fecal coliforms could be increased by modifying the surface pore morphology of the membrane. In this investigation, fecal coliform recovery from polluted water using six types of commercially available membrane filters was compared. The samples were taken from nonchlorinated sewage effluent, and surface waters receiving sewage, farm runoff, and industrial waste water. The membranes tested included: Millipore HA; Millipore HC; Gelman GN-6; Schleicher & Schuell; Sartorius nitrocellulose; and, Johns-Manville. The mean fecal coliform counts on the six test filters are presented. Confirmation ranged from 91.0 to 93.8 percent and indicated no significant differences between the membranes. A statistical analysis performed on the observed differences in count showed that no significant differences between variances of different filter types, however, the differences in mean count were highly significant. The membrane types can be ranked in order of fecal coliform recovery as follows: Millipore HC>Gelman>Johns-Manville and Sartorius>Millipore HA> Schleicher & Schuell.

*Coliforms, *Pollutant identification, *Analytical techniques, Laboratory tests, Membranes, Public health, Standards, Water quality control

Membrane filters

E182
A PILOT STUDY OF DRINKING WATER SYSTEMS IN THE NATIONAL PARK SERVICE,

December, 1974. 77 p, 7 fig, 9 tab, 4 append. EPA-520/9-74-016.

A pilot study was conducted to assess the construction, water quality, operation, maintenance, and surveillance of water supplies on National Park Service Lands. Forty-two water systems in two geographical areas (Maryland, Pennsylvania and Virginia in the East and Arizona and California in the West) were chosen for field investigations. At each water system, samples were collected for bacteriological, chemical and physical analyses; distribution system pressure was determined; and chlorine residuals were measured. It was found that 48% (twenty systems) did not comply with at least one of the constituent limits of the 1962 United States Public Health Service Drinking Water Standards. Eleven systems failed to meet one or more mandatory limits, including fluoride, mercury, and lead. It was recommended that for these supplies, the presence of such metals should be continuously monitored and evaluated. Where bacteriological contamination was found, it was suggested that improved source protection and attention to the sanitary conditions is needed. Only about half the systems tested had an acceptable bacteriological surveillance program. Additionally, none of the chemical analyses performed at any facility included all of the constituents in the Drinking Water Standards. It was also found that, in general, these systems lacked adequate source protection, operation, and control. It was recommended that the National Park Service should place a higher priority on initiating and maintaining further bacteriological and chemical surveillance programs. Costs for adequate programming would be approximately $360 per system.

*Waste water treatment, *Water treatment, *Potable water, *Water quality control, *Water supply, Analytical techniques, Chemical analysis, Bacteria, Maintenance, Operation, Sampling costs, Pollutant identification, Legislation, Water quality standards

Bacteriological analysis, National Park Service

E183
THE COSTS OF BIOLOGICAL WASTE WATER TREATMENT
(DIE KOSTEN DER BIOLOGISCHEN ABWASSERREININGUNG),

Negaard, J.

Federal Institute of Technology,
Dubendorf, Switzerland.

Dissertation No. 5335, Eidgenoessischen Technischen Hochschule Zuerich, Zurich, Switzerland, 1975. 175 p, 45 fig, 12 tab.

Data were collected from 50 Swiss sewage treatment plants. An analysis of these data showed functional relationships between construction and operating costs. For various types of costs, the simultaneous effects of important parameters were determined by multiple regression techniques. This proved to be more reliable than previous research involving only a single parameter. Results of the cost analyses are presented in several tables and graphs.

*Waste water treatment, *Sewage treatment, *Treatment facilities, *Construction costs, *Biological treatment, *Statistical methods, *Cost analysis, *Operating costs, Analytical techniques

Switzerland, Multiple regression

E184
MODEL 6-D IN-SITU WATER QUALITY ANALYZER (SURVEYOR)
HYDROLAB CORPORATION, AUSTIN, TEXAS 78766,

National Oceanographic Instrumentation Center Instrument Fact Sheet, IFS-75004, October, 1974. 15 p, 7 fig.

This fact sheet describes the Hydrolab Corporation's Model 6D In-situ Water Quality Analyzer (Surveyor). The instrument system is portable and measures conductivity, temperature, dissolved oxygen, and pH. Each parameter is measured by a separate sensor contained within the underwater housing or Sonde. Operating power is supplied by a surface control unit and a signal output is displayed on a panel meter. Details are provided on the manufacturer's specifications, performance tests, environmental tests, and on the functions of the National Oceanographic Instrumentation Center.

*Instrumentation, *Analytical techniques, *Water quality, *Dissolved oxygen, *Hydrogen ion concentration, *Temperature, *Conductivity, Operation, Model studies, Water quality control, Equipment, Pollutant identification

National Oceanographic Instrumentation Center

E185
THE USE OF ACTIVABLE TRACERS IN THE EVALUATION OF THE PERFORMANCE OF WASTEWATER TREATMENT PLANTS,

Craft, T. F., and Eichholz, G. G.

Environmental Letters, Vol. 9, No. 3, p 307-325, 1975.

Stable, activable tracers have been used to assess operational conditions in waste water treatment plants. A soluble compound containing an element not normally found in the water or wastes is added to the stream. The suitable tracer element must have a high neutron capture cross section, be available at a reasonable cost, and must be non-toxic in the water at the specified concentration. Such tracers may be used to determine flow rates, residence times, flow paths, and recirculation paths in sewage treatment facilities. The sampling procedure is simple enough to be handled by typical plant personnel; neutron activation analysis facilities are also required and analyses are performed by trained laboratory technicians. Indium and scandium salts proved to be satisfactory tracer elements for the procedure.

*Pollutant identification, *Sewage treatment, *Treatment facilities, *Monitoring, *Tracers, *Neutron activation analysis, Analytical techniques, Personnel, Sampling

Indium, Scandium, Activable tracers

E186
THROUGHFLOW MEASUREMENTS IN WATER AND WASTE WATER TECHNOLOGY (DURCHFLUSSMESSUNG IN DER WASSER- UND ABWASSERTECHNIK),

Wasser Luft und Betrieb, Vol. 19, No. 9, p 514-517, September, 1975. 10 fig.

Methods and instruments used for flow measurement in open canals, and in nonpressure and pressure pipes are described. Venturi sections are commonly used for measurement in open canals and in nonpressure lines; other methods and instruments are also available for measurement in pressure lines. These include measuring orifices, venturi tubes, and devices adopting the principle of differential pressure measurement. Automatic counters permit the measurement of the instantaneous throughflow, the integration of the volume, and the transmission of the measurement values. Inductive flowmeters are suitable for measurement without pressure loss in media with a minimum conductivity of 0.05 microS/cm. Ultrasonic measurement is possible in existing pipelines with a minimum nominal diameter of 300 mm.

*Instrumentation, *Measurement, *Flow, *Waste water treatment, *Water treatment, Equipment, Pressure, Pipelines, Venturi meters, Ultrasoncis, Flowmeters, Flow measurements, Canals

E187
STUDIES ON COLON BACTERIA GROUPS DETERMINATION IN SEWAGE WATER
(Gesuichu no daichokin gun shiken no kento),

Kozama, K.

Gesuido Kyokaishi, Vol. 12, No. 135, p 38-39, August, 1975. 2 tab, 4 ref.

The number of colon bacteria groups produced from secondary treated sewage effluents was determined in sodium deoxycholate and agar culture media. The one ml sample water was placed on the 10 ml sodium deoxycholate in a Petri dish, to which another 10 ml sodium deoxycholate was added and then mixed. This was cultivated in the agar medium for 18 to 20 hr at 35 to 37 C. Colonies were cultivated and it was determined whether or not generation of gas within fermentation tubes had occurred. If so, the colony in the tube was considered as colon bacteria positive. There were basically three colony types produced. These were colonies sized 1 to 3 mm, 0.5 to 1 mm, and less than 0.5 mm. The tested sample water gave 33 colonies of the first type, 12 of the second type, and 44 of the third type. Of these colonies, the colon bacteria positivity was 73%, 83%, and 7% for the first, second, and third types, respectively. The effect of the amount of sodium deoxycholate for the culture on the generation of colony number was also studied. The use of increased amount of sodium deoxycholate decreased the generation of colon bacteria colonies.

*Analytical techniques, *Bacteria, *Sewage effluents, *Pollution identification, *Waste water treatment, *Laboratory tests, Sampling

*Colon bacteria

E188
VIRUSES IN WATER: THE PROBLEM, SOME SOLUTIONS,

Gerba, C. P., Wallis, C., and Melnick, J. L.

Baylor College of Medicine,
Houston, Texas,
Department of Virology and Epidemiology.

Environmental Science and Technology, Vol. 9, No. 12, p 1122-1126, December, 1975. 3 fig, 2 tab, 4 ref.

The public health significance of human pathogenic viruses in water has not yet been determined. Many viruses cause latent or inapparent infections and current epidemiological techniques are not sensitive enough to detect the low-level transmission of viral diseases through water. If domestic waste water is to be recycled in the future, adequate methods must be developed to ensure the elimination of enteric viruses from reclaimed water. Studies have demonstrated that these viruses survive present sewage treatment methods. Concern has also been expressed about the release of viruses into the marine environment through sewage outfalls and polluted rivers. A need exists for better equipped laboratories to perform virological surveys of drinking water supplies. Virus monitoring techniques have been developed for quantifying viruses in shellfish and in landfill leachates. The American Public Health Organization and the World Health Organization have strongly urged that provisional methods for determining viral concentrations in water be identified and that new virus standards be adopted for both potable and nonpotable waters.

*Viruses, *Public health, *Water supply, *Potable water, *Sewage treatment, Sewage effluents, Analytical techniques, Water analysis, Water quality standards, Water pollution control, Monitoring, Waste disposal, Water reuse, Pollutant identification, Laboratory tests

Enteric viruses

E189
STUDIES ON CHARACTERISTICS OF THE SURFACE WATER QUALITY IN KAMEDA DISTRICT,

Misawa, S., Suzuki, M., and Kaneko, A.

Niigata Norin Kenkyu, No. 27, p 27-36, March, 1975. 7 fig, 8 tab, 5 ref.

An investigation of water quality was performed from 1969 to 1973 at Kameda township in the suburbs of Niigata city, Japan. The average electric conductivities of the municipal water at three main water treatment plants were 66.7, 73.8, and 103.2 micro ohm/cm. The average dissolved oxygen was found to be 8.9, 8.4, and 8.2 ppm. The chloride, sodium, potassium, calcium, and magnesium concentrations ranged from 6.5 to 12.4 ppm, 5.9 to 8.9 ppm, 1.5 to 1.8 ppm, 5.9 to 10.5 ppm, and 2.1 to 3.8 ppm, respectively. Sewerage water at 12 drainages during drought season was also analyzed for electric conductivity and for ion concentrations of Cl, Na, K, Ca, and Mg.

*Water quality control, *Municipal water, *Water treatment, Surface waters, Sewerage, Drainage, Treatment facilities, Dissolved oxygen, Pollution identification

E190
CALCULATE CHEMICAL ADDITIVE FEED RATES IN THREE STEPS,

Dwyer, W. V.

Interpace Corporation,
Rochester, New York,
Pulsafeeder Products.

Pollution Engineering, Vol. 7, No. 11, p 40, November, 1975. 1 fig.

A simple nomograph is presented for calculating chemical dosage rates for water and waste treatment plant operations. The formula for the precise calculation of chemical additive feed rate is flow (expressed in mgd) times dosage of treatment chemicals (in ppm) all divided by the feed concentration percent multiplied by the specific gravity of the chemical additive. This figure is then multiplied by a factor of 4.17. Because equipment operation rates are based on different factors than the flow rates for the overall treatment process, this calculation is time-consuming. An illustration of a nomograph which reduces this calculation to three steps to calculate the required feed rate in gallons per hour for a waste stream is provided.

*Waste treatment, *Water treatment, *Chemical reactions, *Graphical methods, Mathematical studies, Flow rates, Operations

*Nomographs, Chemical additive feed rates

E191
POLLUTION CONTROL PLANT STATISTICS,

Water and Pollution Control, Vol. 113, No. 10, p 84-102, October, 1975. 12 tab.

As part of a special "directory" issue, comprehensive statistics are provided on all the municipal pollution control plant facilities in Canada. Information was gathered from regulatory agencies and municipalities. The data are arranged by province and figures are provided on: actual population, population served, a "yes" or "no" on having industrial waste strength bylaws, average daily flow, a combined or separate sanitary sewage system, degree of treatment, plant influent and effluent characteristics, type of treatment, and cost per million gallons of waste water processed.

*Waste water treatment, *Water pollution control, *Facilities, Data collections, *Sewage treatment, Costs, Statistics

*Canada

E192
CONTINUOUS DETERMINATION OF TOC AND TOD (TOC, TOD no renzoku sokutei),

Kajiyama, S.

PPM, No. 9, p 32-39, September, 1975. 2 fig, 4 tab, 16 ref.

Continuous monitoring methods for total organic carbon and total oxygen demand (TOC and TOD) were discussed. The continuous TOC measurement is made by introducing sample water into a catalytic combustion tube and generating carbon dioxide gas which is measured by NDIR. The measured CO2 absorption is the total carbon content in water; therefore, the inorganic carbon contribution must be subtracted from the measured TC to give TOC. This is done by treating the sample water with phosphoric acid and ammonium persulfate in a catalytic tube at 150 C. The generated CO2 gas may then be attributed to inorganic carbon. TOD is measured by generating gaseous compounds from the sample water in a catalytic tube at 900 C and reacting the generated gases with oxygen. After the reaction, the unreacted oxygen concentration is measured by an oxygen detector such as a Pt-Pb liquid fuel cell. The determination error is caused by the dissolved oxygen in the sample water, the presence of inorganic compounds having the capability of liberating oxygen, and the uncertainity in oxidation efficiencies of different compounds. In both TOC and TOD measurements, the correlation between analytical instruments by different manufacturers with the analytical values is very poor and calibration methods differ.

*Monitoring, *Analytical techniques, *Pollutant identification, Organic compounds, Water analysis, Absorption, Water quality, Water pollution control

Total Organic Carbon (TOC)

E193
ELEMENTAL ANALYSIS OF WASTEWATER SLUDGES FROM 33 WASTEWATER TREATMENT PLANTS IN THE UNITED STATES,

Salotto, B. V., Grossman, E. III, and Farrell, J. B.

U. S. Environmental Protection Agency, Cincinnati, Ohio,
Ultimate Disposal Section, Treatment Process Development Branch,
Advanced Waste Treatment Research Laboratory.

In: Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, May 21-22, 1974, New Brunswick, New Jersey, Rutgers University, p 23-71. 7 fig, 11 tab, 17 ref.

Sludges, principally of the digested type, from 33 municipal waste water treatment plants in the United States, have been analyzed for 21 metals, and nitrogen, phosphorus and sulfur. The plants sampled ranged from small plants in urban communities to large plants in large cities. Some plants used primary treatment, some used secondary aeration and most used anaerobic digestion. Metal content was determined by an atomic absorption procedure. No detectable amount of beryllium was found in any sludge sample analyzed and although very toxic, it does not present a hazard in sludge disposal. Mathematical analysis of the data indicated that the distribution of heavy metals in sludge is approximately log-normal. This behavior is characteristic of all sludge types analyzed so far. Levels of metal in essentially domestic sludges were found to correspond closely to the 25th percentile distribution of metals in all sludges reported. Comparison of the levels of metals in United States sludges with corresponding levels in Scandinavian sludges showed higher levels in United States sludges. Variation of any particular metal in sludges of a particular waste water treatment plant was much less than in sludge samples taken from different plants. The contents of nitrogen, phosphorus, sulfur and volatile solids and heat of combustion were also determined for sludge samples. Heat of combustion was generally higher for raw primary sludge than for digested sludge because of the greater amounts of volatile solids. Phosphorus and sulfur were concentrated in digested sludge while nitrogen had a lower concentration.

*Waste water treatment, *Sludge, *Chemical analysis, Pollutant identification, Metals, Treatment facilities, Municipal wastes, Mathematical studies, Anaerobic digestion

E194
PRELIMINARY SUMMARY OF SLUDGE DEGRADATION STUDIES IN A MARINE BENTHIC ENVIRONMENT,

Muellenhoff, W. P.

Environmental Protection Agency, Corvalis, Oregon,
Coastal Pollution Branch,
Pacific Northwest Environmental Research Laboratory.

In: Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, May 21-22, 1974, New Brunswick, New Jersey, Rutgers University, p 349-389. 9 fig, 7 tab, 25 ref, 1 append.

The rate and extent of the decrease of organic carbon in a digested domestic sewage sludge deposited on the sea floor were determined in laboratory and field tests. Total carbon (TC) and total inorganic carbon (TIC) were measured as indicators of the stabilization process, and sulfate, phosphate, nitrate, and Kjeldahl nitrogen were measured to record the chemical characteristics of the sludge. Concentrations of TC were found to decrease approximately 70% after 80 days at a pressure of one atmosphere. The TC decreased 30% in 47 days at increased pressure to simulate the deep sea. Oxygen consumption rates ranged from 3.74 to 0.55 02/sq m/day depending on the sludge source, type of digestion and time since deposit. Dissolved oxygen was depleted beyond one cm in the bed. Oxidation-reduction potential ranged from +150 mv at the sludge bed surface to -100 mv at 2 cm. Diffusion of hydrogen sulfide into underlying sediments began at 24 days and proceeded at a rate of 0.09 mm/day. Due to compaction, sludge beds decreased to one-half their original thickness in 80 days. Approximately 60% of all compaction occurred in the first day. A mathematical model of dissolved particulate and gaseous fractions of sludge bed carbon is being formulated to better understand the mechanisms and transfer rates of the sludge bed carbonaceous materials.

*Sludge, *Degradation (decomposition), Sewage sludge, Domestic wastes, Sewage, Carbon, Organic compounds, Inorganic compounds, Stabilization, Sulfates, Phosphates, Mathematical model, Oxidation-reduction potential, Dissolved oxygen, Benthic flora

E195
BIOASSAY METHODS AND IMPACT EVALUATION OF OCEAN DISPOSAL SITES,

Dorfman, D. and McCormick, J. M.

In: Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, May 21-22, 1974, New Brunswick, New Jersey, Rutgers University, p 391-415. 4 fig, 2 tab, 23 ref.

Some disadvantages of land disposal of effluents and sludges include lack of adequate space; adverse effects on the water table; aesthetics; and high costs. Discharges into ocean waters will probably expand in the future but the oceans' capacity for wastes is not limited. Large quantities of ocean disposed effluents and sludges can result in increased nutrients and toxicants, biochemical and chemical oxygen demand, direct or indirect reduction in the dissolved oxygen, altered salinities, increased turbidity and temperatures, smothered benthic organisms, and a number of synergistic and antagonistic reactions. Bioassay methods and impact evaluation techniques in relation to these problems are discussed. A number of both laboratory and field procedures are available to perform bioassays, but to perform them on marine water some modifications are necessary due mainly to the presence of salt water and the quality of the waters. Two types of bioassays are considered. A static bioassay is one in which the test organisms are maintained in vessels containing solutions of various dilutions of the toxic material. In the flow through bioassay the test solution is allowed to flow in and out of the vessel containing the test organisms, maintaining a constant chemical environment. This is preferred for long term assays. Sub-lethal tests that can be performed include biochemical studies, pathological studies, physiological studies, growth studies, behavior studies, photosynthesis studies and taste tests. Field observations can provide the only direct evidence of the effects of ocean waste on the flora and fauna. A multidisciplinary approach, using both field and laboratory tests appears to be the most satisfactory.

*Bioassay, *Sludge disposal, *Disposal, Effluents, Biochemical oxygen demand, Chemical oxygen demand, Dissolved oxygen, Benthic flora, Benthic fauna, Water table, Waste disposal, Toxins, Nutrients

*Impact evaluation, Land disposal, Ocean disposal, Sub-lethal tests

E196
THE RATE OF PSYCHROPHILIC AND MESOPHILIC BACTERIA IN DIFFERENTLY POLLUTED WATERS OF BUDAPEST (A PSYCHROPHIL ES A MESOPHIL BAKTERIUMOK SZAMANAK ARANYA KUELOENBOEZO SZENNYEZETTSEGII BUDAPESTI VIZEKBEN),

Nemedi, L., and Petrasko, G.

Egeszsegtudomany, Vol. 19, No. 3, p 239-525, 1975. 2 fig, 4 tab, 23 ref.

The kinetics of psychrophilic and mesophilic bacteria populations in water with different levels of pollution were studied. Two different culturing techniques for bacteria enumeration were employed. The mean values of bacterium counts were found to be consistently higher with gelatin plate pouring (incubation at 20 C for 4 days) than with agar plate pouring (incubation at 37 C for 2 days). Because of this variation, the hygienic limit values of the two parameters can not be determined in identical values. The psychrophilic count was found to be more strongly correlated with the fecal pollution of waters than was the mesophilic count. The proportion of psychrophilic and mesophilic bacterium counts varied between 3.2 and 20. The relative frequency of the two bacteria populations observed in the polluted waters of Budapest is presented. The extent to which the different culturing methods might modify the water analysis based on the bacterium count is discussed. It is stressed that the hydrobiological and hygienic value of the bacterium count varies.

*Waste water treatment, *Bacteria, *Water quality, *Water pollution, Analytical techniques, Pollutant identification

Mesophilic bacteria, Psychrophilic bacteria

E197
THE MOLECULAR WEIGHT DISTRIBUTION OF SOLUBLE ORGANICS IN SEWAGE AND SEWAGE EFFLUENTS USING GEL FILTRATION,

Carton, R. J.

Dissertation Abstracts International B, Vol. 36, No. 5, p 2138, November, 1975.

In order to develop more sophisticated waste water treatment systems, our knowledge of specific chemical and physical changes occurring in sewage must be increased. The molecular weight distribution of soluble organic compounds in sewage, and in biologically and chemically treated effluents determined by gel filtration is described. Raw sewage and activated sludge effluent samples were take from the Bernardsville, New Jersey, sewage treatment plant. Particulates were removed by sedimentation, ultracentrifugation, and filtration through a Millipore filter. Samples of raw sewage and effluent were also coagulated with ferric chloride, filtered and eluted on Sephadex. Samples containing less than 30 mg/liter TOC were concentrated by flash evaporation at 40 C. The soluble fraction of raw sewage contained a continuous distribution of TOC from 0 to 1500 MW. The exclusion peak at Vo contained 21% of the organic carbon. About 40-50% of the TOC was partially adsorbed on the column. Concentration of the soluble fraction of raw sewage by flash evaporation changed the molecular weight distribution. One-third of the compounds above 1500 MW were coagulated and removed by filtration through a 0.45 micrometer Millipore filter. Coagulation with ferric chloride produced alterations in the molecular weight distribution. No peak was present at 1500 MW, and the amount of low molecular weight compounds doubled. A possible explanation for this phenomenon is that colloidal particles exchange the low molecular weight compounds for ferric and chloride ions, and then the colloidal particles and high molecular weight compounds are coagulated. About 42% of the activated sludge effluent of the TOC compounds were greater than 1400 MW as compared to about 20% for raw sewage.

*Waste water treatment, *Sewage, *Activated sludge, Organic compounds, Molecular weights, Adsorption, Analytical techniques

Total organic carbon

E198
PROGRESS REPORT: BLUE SPRINGS LAGOON STUDY, BLUE SPRINGS, MISSOURI,

Walter, C. M., and Bugbee, S. L.

U. S. Environmental Protection Agency,
Regional Laboratory, Region VII,
Kansas City, Kansas.

In: Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards, August 21-23, 1974, Logan, Utah, Utah State University, p 191-197. 9 tab, 1 ref.

The Federal Water Pollution Control Amendments were passed in 1972. They provided the legislation for controlling the discharge from municipal and industrial waste sources. Permits granted under the National Pollutant Discharge Elimination System require secondary treatment by 1977. Standards are 30 mg/liter for 5 day biochemical oxygen demand (BOD(5)), 30 mg/liter for suspended solids, and 200 organisms/100 ml for coliform densities. These standards were tested for the three-cell, in a series lagoon system at Blue Springs, Missouri. The objectives of the tests were: to determine the performance of a three-cell, series operated, lagoon; to determine the relative performance of the three cells; and to determine the feasibility of slow sand filtration. Two sand filters were used for the tests, one with an effective sand size of 0.3 mm and the other, 0.22 mm. Laboratory analyses were conducted for biochemical oxygen demand, chemical oxygen demand, suspended solids, nitrogen, phosphorus, coliforms and various metals. During the winter, 84% of the BOD(5) removal occurred in Cell 1 and none in cells 2 or 3. Cells 2 and 3 reduced COD and suspended solids by 32% and 23%, respectively. The fecal coliform count was reduced from 475,000 to 22,000 organisms/100 ml. In the spring, BOD(5) removal was 88%. BOD(5) and suspended solids concentrations both met the secondary treatment criteria, while the coliforms were in excess of the limit. Data for the summer were in the process of being generated.

*Lagoons, Permits, Regulation, Legislation, Standards, Suspended solids, Biochemical oxygen demand, Coliforms, Waste water treatment, Chemical analyses, Sands, Filters, Missouri, Federal Government, Discharge (water)

E199
COST-EFFECTIVENESS ANALYSIS FOR WATER POLLUTION CONTROL,

Smith, R.

Office of Research and Development,
Environmental Protection Agency, Cincinnati, Ohio,
National Environmental Research Center.

In: Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards, August 21-23, 1974, Logan, Utah, Utah State University, p 199-226. 20 fig, 20 ref, 2 append.

Over the last ten years, the Environmental Protection Agency has shifted its emphasis from the purely scientific aspects of pollution control to the study of design and cost-effectiveness. The concept of cost-effectiveness is very closely related to that of best practicable treatment which was set up as a goal to be reached in 1983. The concept of cost-effectiveness is discussed. All feasible alternatives to achieving the required level of treatment should be evaluated and cost analyzed. Other considerations besides cost may include: expected residential and industrial growth; infiltration and inflow impact on the treatment facilities; reusing treated waste water in industry or agriculture; least costly treatment process; factors such as sludge retention time, hydraulic detention time, water temperature and final settler overflow rate; the impact on improved methods of operation and maintenance on effluent quality; and the integration of storm water facilities with dry water treatment facilities. Cost-effectiveness guidelines make no allowance for inflation in wages, power costs or capital cost. In order to make a cost comparison, stream of costs must be converted to one of three bases: present worth, or lump sum expenditure at the beginning of a planning period; future worth, at the end of a planning period; or continuous cash flow at a fixed rate. Conversion equations and diagrams are presented. Cost-effective analysis is applied to a proposed activated sludge plant for a municipal community.

*Cost analysis, *Economics, *Water pollution control, *Analysis, Design, Treatment, Waste water treatment, Mathematical studies, Cost comparisons, Planning

Cost-effectiveness analysis

E200
INVESTIGATIONS ON THE MICROBIAL REDUCTION OF SULPHATES,

Domka, F., and Gasiorek, J.

Mickiewicz University,
Grunwaldzka, Poland,
Institute of Chemistry.

Acta Microbiologica Polonica, Ser. B., Vol. 7, No. 1, p 61-72, 1975. 11 fig, 3 tab, 13 ref.

The kinetics of the microbiological reduction of sulfates have been investigated. The reduction was carried out by Desulfovibrio. Microbial reduction of sulfates may be applied for industrial purposes, including the use of phosphogypsum, gypsum, or anhydrite wastes as raw materials for sulfur or sulfuric acid production. Sewage sludge, enriched with calcium sulfate, may also be utilized. In this paper, optimal conditions were defined for the reaction and were found to be at 35 degrees and pH 7. The reaction order, kinetics equation, and the effects of the temperature and pH of the medium on the conversion of sulfate to sulfide were also presented.

*Kinetics, *Sulfates, *Microorganisms, *Microbial degradation, Sulfur, Equations, Analytical techniques, Waste treatment, Industrial water

E201
WATER WORKS PLANT STATISTICS,

Water and Pollution Control Directory, Vol. 113 No. 10, p 48-66, October, 1975. 11 tab.

A comprehensive listing of Canada's municipal water works facilities is presented. The information was gathered from many municipalities and regulatory agencies, and serves as a national reference. Eleven tables are provided which detail the characteristics of each facility; these are arranged alphabetically by province. Included are: raw water characteristics (pH, total hardness, turbidity, and color); population served; actual population; source of water supply; ownership of system; type of treatment (aeration, chlorination, carbon, flocculation, filtration, fluoridation, iron removal, sedimentation, softening, sludge treatment, nutrient removal); plant design capacity; storage capacity; number of service connections, including domestic, industrial and commercial; costs per thousand gallons; and potable water supplied to other municipalities.

*Treatment facilities, *Potable water, *Water treatment, *Water supply, *Municipal water, Water quality, Statistics, Costs, Design

*Canada, *Water works plant statistics

E202
SEASONAL OCCURRENCE AND DISTRIBUTION OF MICROBIAL INDICATORS AND PATHOGENS IN THE RHODE RIVER OF CHESAPEAKE BAY,

Carney, J. F., Carty, C. E., and Colwell, R. R.

Maryland University, College Park, Department of Microbiology.

Applied Microbiology, Vol. 30, No. 5, p 771-780, November, 1975. 3 fig, 6 tab, 19 ref.

Coliforms and fecal streptococci have been used as indicators of other pathogenic bacteria associated with fecal contamination. Increasingly heavy nutrient loads have protected microorganisms that would normally die off. Indicator organisms were evaluated as part of a larger study of the microbial ecology of the Rhode River, a small subestuary area of Chesapeake Bay. Four sampling sites were set up at various places in the estuary. Water samples were collected all year at one meter depths, and analyzed for conductivity, salinity, temperature, dissolved oxygen, and turbidity. Water samples were plated on estuarine salt-water-yeast extract agar, and incubated for 2 weeks at 15 C. Standard methods of analysis were used to determine total coliform, fecal coliform, and fecal streptococci counts. Clostridium botulinum, Salmonella spp., and V. parahaemolyticus were also measured. Results show that the highest frequency of occurrence of total and fecal coliforms and fecal streptococci was in Muddy Creek, a marsh area which receives most of its runoff from pasture lands. The second highest frequency of occurrence was found in Cadle Creek, which is near populated land. Lowest measurements of these organisms were obtained in the central portion of the Rhode River. Clostridium botulinum was found in about 12% of the samples. Salmonella spp. was not found in any of the samples. V. parahaemolyticus was found near populated areas in the summer months.

*Indicators, *Microorganisms, *Pathogenic bacteria, *Bacteria, Coliforms, Streptococcus, Pollutant identification, Estuaries, Chesapeake Bay, Clostridium, Salmonella

E203
DETECTION OF SALMONELLAE IN THE ENVIRONMENT,

Thomason, B. M., Biddle, J. W., and Cherry, W. B.

Center for Disease Control, Atlanta, Georgia.

Applied Microbiology, Vol. 30, No. 5, p 764-767, November, 1975. 4 tab, 9 ref.

It has been suggested that salmonellae may be free living in nature since they have been found in waters devoid of fecal contamination. They may also be a better indication of a health hazard than the standard coliform count. The incidence of salmonellae in a harsh and unfavorable environment was determined as compared with that of a lush hardwood forest characterized by abundant moisture and moderate temperature. Samples were taken from two sites: one was a mature hardwood forest which is protected against casual human intervention but which had many warm and cold blooded vertebrates; the other the top of a granite mountain which receives heavy human usage, but can support only a small animal population. Water, algae, mosses, tree roots, grasses, and soils were collected for sampling. Samples collected in the lush hardwood forest yielded four salmonellae serotypes from six culturally positive samples. Out of a total of 76 samples collected at the top of the granite mountain over a three month period, 10 were positive. Only two salmonellae serotypes were isolated, and one of these was isolated only once. The detection of salmonellae was independent of the nature of the material collected and analyzed for the two sites, but the presence or absence of visible moisture had a significant effect on the recovery of salmonellae. Even a harsh environment can serve as an ecological niche for the survival and transmission of salmonellae.

*Salmonella, *Environmental effects, *Pollutant identification, Hazards, Coliforms, Forests, Mountains, Granites, Hardwood, Public health

Granite mountain, Hardwood forest

E204
AUTOMATED DETERMINATIONS OF DISSOLVED ORGANIC CARBON
IN LAKE WATER,

Goulden, P. D., and Brooksbank, P.

Canada Center for Inland Waters,
Burlington, Ontario.

Analytical Chemistry, Vol. 47, No. 12, p 1943-1946, October, 1975. 2 fig, 2 tab, 5 ref.

Several automated methods for the determination of dissolved organic carbon (DOC) in water from the Great Lakes were compared. Dissolved organic material, which may represent degradation of animal or plant products, or pollution by sewage, is measured by the oxidation of the organic material with subsequent measurement of carbon dioxide. Inorganic carbonate must be removed prior to the oxidation step. In these examples, the inorganic carbonate was removed by stripping the carbon dioxide from an acidified sample in a heated packed column. The two alternative methods of oxidation were compared, using ultraviolet irradiation and silver-catalyzed peroxydisulfate at 95 C. It was found that ultraviolet irradiation will oxidize all the organic materials. The silver-catalyzed peroxydisulfate method was convenient and precise but oxidized only 97% of the naturally occurring organic materials. For all the systems, using wet oxidation for high sensitivity, the limit for detection of carbon was 10 micrograms/liter and the analysis rate was 20 samples per hour.

*Organic materials, *Automation, *Analytical techniques, *Water analysis, *Great Lakes, Carbon dioxide, Ultraviolet irradiation, Oxidation, Pollutant identification

Dissolved organic carbon (DOC)

E205
FACTORS AFFECTING RESPIRATORY QUOTIENT--APPLICATION TO PURE OXYGEN SYSTEMS,

Mueller, J. A., and Pannu, A. S.

Manhattan College,
Bronx, New York,
Department of Environmental Engineering and Science.

In: Proceedings of the 29th Industrial Waste Conference, May 7-9, 1974, Purdue University, Lafayette, Indiana, p 846-856, 1975. 7 fig, 8 tab, 14 ref.

Factors influencing the design of pure oxygen aeration systems for both municipal and industrial wastes are discussed. Models have been developed relating gas transfer kinetics to the liquid phase biological oxidation kinetics. To accurately model complex waste treatment systems, basic biological parameters such as respiratory quotient (RQ) and cell composition are required. Because data on these parameters is generally non-definitive, experimental studies are needed. The factors affecting RQ have been shown to be: type of substrate; type of nitrogen nutrient; substrate removal efficiency, F/M loading cell yields and decay coefficients when nitrate is used as growth nutrient; and formation of partially oxidized intermediates. An often neglected parameter that can be used to quantitatively follow biological growth, denitrification, and nitrification is the alkalinity change. This can be easily monitored and gives an indication of nitrogen utilization.

*Aeration, *Waste water treatment, *Biological treatment, Waste treatment, Alkalinity, Nitrification, Denitrification, Monitoring, Model studies, Analytical techniques, Aeration, Oxidation, Kinetics

Respiratory quotient (RQ)

E206
TOTAL OXYGEN DEMAND,

Ravenscroft, B. D.

Northumbrian Water Authority, Gosforth, Newcastle upon Tyne,
Great Britain.

Proceedings of the Analytical Division of the Chemical Society, Vol. 12, No. 9, p 254-255, September, 1975.

Deficiencies and delays in classical methods of oxygen demand measurements on waste water and new rapid determination methods are discussed. Biochemical oxygen demand (BOD), chemical oxygen demand (COD), and permangate value (PV) measurements have given way to total carbon (TC), total organic carbon (TOC) and total oxygen demand (TOD) techniques. In the TOD instrument discussed, the sample is catalytically burned at 900 C with a small and constant stream of oxygen. This instrument is more accurate in the 0-500 mg/liter of TOD and 0-1000 mg/liter of TOD ranges than in the 0-50 mg/liter of TOD range. Dissolved and suspended solids can be handled with this instrument, as long as they are smaller than 200 microns. The oxidation efficiency at 900 C for the TOD measurements is greater than that for the COD measurements. Dissolved oxygen and nitrates in the sample will interfere with TOD measurements, and so must be either corrected for or eliminated. Effects from other anions are negligible. Heavy metals may poison the catalyst. Correlations between TOD, COD, and BOD are dependent on the composition of the waste water being studied. Industrial applications include: on-line operation to protect from spills; detection of losses where expensive products are made; and industrial final effluent monitoring.

*Oxygen, *Biochemical oxygen demand, *Chemical oxygen demand, Chemical analysis, Waste water (pollution), Pollutant identification, Equipment, Instrumentation

Permangate value, Total carbon, Total organic carbon, Total oxygen demand 6 11

E207
INTERFERENCES IN THE ELECTROANALYTICAL DETERMINATION OF COPPER AND LEAD IN WATER AND WASTE WATER,

Barnes, D., Cooksey, B. G., Metters, B., and Metters, C.

Strathclyde University, Glasgow, Scotland, Department of Civil Engineering.

Proceedings of the Analytical Division of The Chemical Society, Vol. 12, No. 9, p 251-252, September, 1975. 2 fig, 1 tab, 10 ref.

Heavy metals can exist in aqueous solutions in dissolved, precipitated, complexed, and adsorbed forms. Toxicity, treatment efficiency, and concentration determinations are affected by the form. Electroanalytical techniques are useful in that they are sensitive, non-destructive, and informative. Samples of final effluent from an activated sludge process were analyzed by d. c. polarography, anodic stripping voltametry, particle size analysis, and atomic absorption spectrometry. Lead was added to the sewage at concentrations of 1-20 parts per million (ppm), and these solutions were analyzed by d. c. polarography. The lead did not exist in a free soluble form at pH 7. The calibration graphs were curved. When the acidity was increased the calibration graphs were straight lines. Similar results were obtained with copper. At lower concentrations of lead, anodic stripping voltametry was used. Calibration graphs still were curved at a pH of 7, and became straight lines when the solution acidity was raised. Graphs for centrifuged samples were more linear than for uncentrifuged samples. Combined particle size analysis, centrifugation and suspended solids addition showed that adsorption can occur at low concentrations (on the order of parts per billion). At higher concentrations, the adsorption sites are saturated. The chemical form of metals in solution is dependent upon: pH; the concentration of the metal; the amounts of organic material and suspended solids; and the concentration and type of anion.

*Copper, *Lead, *Waste water (pollution), Pollutant identification, Calibrations, Acidity, Sewage, Analytical techniques, Chemical analysis, Activated sludge, Particle size, Centrifugation, Polarographic analysis

*Electroanalysis, Anodic stripping voltametry, Calibration graphs

E208
MERCURY DYNAMICS IN A WARMWATER STREAM RECEIVING MUNICIPAL WASTEWATER,

Bainbridge, K. L., D'Itri, F. M., and Bahr, T. G.

Michigan State University, East Lansing, Institute of Water Research.

In: Proceedings of the 29th Industrial Waste Conference, Part Two, May 7-9, 1974, Lafayette, Indiana, Purdue University, p 597-607. 2 fig, 5 tab, 36 ref.

Substantial amounts of mercury are removed in the activated sludge process. A mercury budget for the East Lansing, Michigan, Sewage Treatment Plant was developed. Mercury levels in fish, benthos, water and sediment taken from a stretch of the Red Cedar River which receives the plant's effluents, were determined. The effects of mercury fungicides applied to a golf course adjacent to a river were determined. Four sampling stations were set up on the river. Samples collected included: sediments; benthos; sludge filter cake; water; raw sewage; final effluent; fish; and crayfish. The flameless atomic adsorption technique was used to measure total mercury. The mean concentration of mercury in the sediment ranged from 0.04 parts per million (ppm) upstream to 0.40 ppm downstream. Mercury concentrations in fish ranged from 0.17 ppm to 0.72 ppm. Predator species contained two to three times as much mercury as grazers or bottom feeding omnivores. Mean mercury concentrations of 0.15 ppm were found in Chironomids collected right below the sewage treatment plant outfall. It was estimated that about 70 grams of mercury per day enter the sewage treatment plant and about 20 grams per day enter the river through the outfall. The rest is adsorbed onto the sludge which is filtered and incinerated, causing the mercury to be released into the atmosphere. Only weak evidence suggests that mercury from the fungicides used on the golf course, which have been stopped, were entering the river.

*Mercury, *Municipal wastes, Activated sludge, Treatment facilities, Sewage treatment, Waste water treatment, Fish, Benthos, Michigan, Golf courses, Fungicides, Chemical analysis, Sludge

E209
COMPARATIVE ATOMIC ABSORPTION SPECTROSCOPIC STUDY OF TRACE METALS IN LAKE WATER,

Surles, T., Tuschall, J. R., and Collins, T. T.

Limnetics, Incorporated, Milwaukee, Wisconsin.

Environmental Science and Technology, Vol. 9, No. 12, p 1073-1075, November, 1975. 3 tab, 10 ref.

The advantages of flameless atomic absorption spectroscopy over the conventional flame technique include: lower detection limits; less sample pretreatment; smaller sample size; rapid analysis; and a greater variety of samples. However, there is still controversy over the precision and accuracy of the flameless technique. The precision and accuracy of the flameless method as compared to the flame technique and the chelation/solvent extraction method is demonstrated. A Perkin-Elmer Model 306 atomic absorption spectrophotometer was used with a Deuterium Background Corrector in the study. Nitric acid was used as a final cleaning agent. Composite water samples were taken from six different locations along Lake Michigan's western shoreline. The chelation/extraction method and the flameless method were used to determine the concentrations of cadmium, zinc, copper, chromium, manganese, lead, and nickel in the water. It was possible to analyze wide ranges of concentrations without prior dilution or concentration with the flameless method. In order to work in the same range as the flameless method, the chelation/extraction method required tedious preconcentration of the sample. Concentrations for some of the metals were too low to be determined by the chelation/extraction method. One problem with this method is the probable loss of metal in the chemical procedure of the extraction technique. When radioactive cadmium was used as a sample, the flameless technique showed results that were in better agreement with radioactive techniques than did the chelation/extraction method.

*Trace elements, *Metals, Spectroscopy, Chemical analysis, Pollutant identification, Chelation, Lake Michigan, Analytical techniques, Instrumentation

Atomic absorption spectroscopy, Flameless atomic absorption spectroscopy, Chelation/extraction technique, Perkin-Elmer Model 306, Deuterium Background Corrector

E210
POTABLE WATER QUALITY IN RURAL GEORGETOWN COUNTY,

Sandhu, S. S., Nelson, P., and Warren, W. J.

South Carolina State College, Orangeburg, Department of Natural Sciences.

Bulletin of Environmental Contamination and Toxicology, Vol. 14, No. 4, p 465-472, October, 1975. 1 fig, 3 tab, 20 ref.

The drinking water quality of rural homes and communities in Georgetown County, South Carolina, was investigated in order to determine: the level of inorganic constituents; whether they exceed federally recommended limits; and whether pollution sources can be identified. Drinking water supplies in 161 rural communities were selected for sample collection. Samples were chosen that had not been chlorinated or otherwise pretreated. Samples were analyzed according to standard methods for pH, temperature, chlorides, nitrates, total residues, turbidities, sodium, fluoride, copper, iron, manganese, zinc, and mercury. Results showed that most of the waters were slightly acidic. Low but acceptable concentrations of chloride, copper, fluoride, sodium, cadmium, nitrate, and phosphate were found. Some water samples showed higher than recommended levels of arsenic, mercury, zinc, and lead. Two percent of the samples exceeded the mandatory limit of 0.05 parts per million (ppm) for arsenic, and 72% exceeded the recommended level of 0.01 ppm. Mandatory limits for manganese and iron were exceeded in 37% and 88% of the waters, respectively. The high iron content was responsible for the high turbidity found in 45% of the samples. Well depth and consumer income affected water quality. Septic tank seepage was partially responsible for nitrate, phosphate, iron, and arsenic contaminations. Lead concentrations depended on the plumbing and the pH.

*Water quality, *South Carolina, *Potable water, Chemical analysis, Pollutant identification, Rural areas, Inorganic compounds, Waste water (pollution)

Georgetown County (SC)

E211
HORIZONTAL SPREAD OF WASTEWATER FIELD OVER CALM OCEAN SURFACE,

Chao, J. L.

Journal Water Pollution Control Federation, Vol. 47, No. 10, p 2504-2510, October, 1975. 2 fig, 18 ref.

Discharge of waste water into the ocean by cities and industries demands effective dilution of the effluent for oxidation and assimilation of the waste. Because of the complexity of ocean outfall system designs, the problem of horizontal spread of waste water in the absence of ocean currents was analyzed, and design guidelines were established for the practicing engineer. Since the primary purpose of the paper was to provide a simple method for estimating the dilution resulting from horizontal spread, flow characteristics were simplified and assumptions were made. It was pointed out that the subsequent dilution resulting from horizontal spread is relatively low in magnitude in comparison with the initial dilution that the effluent buoyant plume receives.

*Waste assimilation capacity, *Waste water disposal, *Oceans, *Effluents, Design criteria, Engineering, Water pollution effects, Pollutant identification, Flow characteristics

Pollutant transport

E212
APPLICATION OF ENERGY-DISPERSIVE X-RAY FLUORESCENCE TO TRACE METAL ANALYSIS OF NATURAL WATERS,

Elder, J. F., Perry, S. K., and Brady, F. P.

California University,
Davis,
Crocker Nuclear Laboratory.

Environmental Science and Technology, Vol. 9, Number 12, p 1039-1042, November, 1975. 3 fig, 3 tab, 20 ref.

Energy-dispersive x-ray fluorescence (XRF) is a new technique which provides for simultaneous multielement analysis. The technique has been applied to the analysis of dissolved trace metals in water. The dissolved elements must first be transferred to a uniform target suitable for analysis. This is accomplished by precipitating the elements with the nonspecific chelating agent, ammonium-1-pyrrolidine dithicarbamate, and by membrane filtration. The method is useful for the analysis of most transition metals and for many types of aqueous samples. Data from the Lake Tahoe basin were used to illustrate typical sensitivity and background levels.

*X-ray fluorescence, *Trace elements, *Metals, Pollutant identification, Equipment, Water analysis, Membrane processes, Chemical precipitation, Analytical techniques, California

Spectrometry, Multielement analysis, Energy-dispersive XFR

E213
EVIDENCE FOR NEW ALUMINIUM PHOSPHATE PHASE FROM REACTION RATE OF PHOSPHATE WITH ALUMINIUM HYDROXIDE,

Van Riemsdijk, W. H., Weststrate, F. A., and Bolt, G. H.

Agriculture University,
Wageningen, The Netherlands,
Department of Soils and Fertilizers.

Nature, Vol. 257, No. 5527, p 473-474, October 9, 1975. 2 fig, 1 tab, 8 ref.

In systems where waste water is disposed directly onto the soil, the reaction between phosphate and aluminum hydroxide is an important one. It has been suggested that the precipitation of phosphate occurs when raw sewage water is applied to sandy topsoil for an extended period of time. The presence of an aluminum phosphate has been indicated as the main fraction of phosphate retained. Experiments on this precipitation reaction were performed at 20.5 ± 0.1 C with an initial phosphate concentration of 0.36 mmol/cu dm at a pH of 5. Results of the measurements are presented in a semi log plot of the measured phosphate concentration as a function of reaction time for a suspension concentration of 0.2 g/cu dm Al(OH)3. An increase in reaction rate on the graph was hypothesized to be due to the initiation of the growth of a crystalline aluminum phosphate. This supposition was tested using electron microscopy, electron diffraction, and X-ray diffraction. From the results, crystalline structures with a measured value agreeing with those of sterrettite were found. Evidence indicated that the growth of an aluminum phosphate phase was the rate determining step after a particular point on the graph.

*Phosphates, *Nutrient removal, Kinetics, Waste water disposal, Aluminum, Chemical precipitation, Soils, Sewage disposal, Pollutant identification, Analytical techniques

Aluminum phosphate, Sterrettite

E214
A TECHNIQUE FOR ESTIMATING ACTIVE NITRIFYING MASS AND ITS APPLICATION IN DESIGNING NITRIFYING SYSTEMS,

Srinath, E. G., Prakasam, T. B. S., and Loehr, R. C.

Cornell University, Ithaca, New York, Department of Agricultural Engineering.

In: Proceedings of the 29th Industrial Waste Conference, Part Two, May 7-9, 1974, Lafayette, Indiana, Purdue University, p 1038-1048. 7 fig, 3 tab, 14 ref.

Various methods are available for estimating the active mass of the sludge in an aerobic treatment process, based on the biochemical characteristics of the aerobic organisms. In nitrifying systems, mixed liquor volatile suspended solids (MLVSS) is used as the parameter and is usually very crude. Results from research on the process of nitrification were used to develop a parameter for the active mass of nitrifying organisms. The oxidation rates of ammonium and nitrite of the mixed liquors (expressed as milligrams of substrate nitrogen oxidized per hour per milligram of cellular total Kjeldahl nitrogen (TKN) of the mixed liquor) were compared with the rates obtained with pure cultures of Nitrosomenas europaea, Nitrobacter agilis, and N. winogradskyi suspended at a known concentration (milligrams of cellular TKN/liter) in a mineral salt medium containing their respective substrates, ammonium and nitrite. The reference pH for determining the rates was in the range of 7.4 to 7.9 since the maximum rates were obtained in this range. The ratio between the specific rates of oxidation of the mixed liquor nitrifying population and the pure cultures under similar conditions of pH and temperature represents the fraction of the TKN of the mixed liquor as contributed by the cellular TKN of the autotrophic nitrifiers. This ratio when multiplied by the TKN concentration of the mixed liquor, gives the TKN concentration of the nitrifying organisms, which can be used as an estimate of their mass.

*Analytical techniques, *Nitrification, *Nitrogen, *Nitrites, Suspended solids, Pollutant identification, Waste water treatment, Sludge, Aerobic treatment, Oxidation, Microorganisms

E215
EVALUATION OF IN-LINE AND SIDE-LINE FLOW EQUALIZATION SYSTEMS,

Foess, G. W., Meenahan, J. G., and Blough, D.

Water and Sewage Works, Vol. 122, No. 11, p 59-60, November, 1975.

Despite advantages ascribed by various investigators, flow equalization has not been widely applied in the municipal pollution control field because of uncertainties in the areas of costs and beneficial effects. Two waste water treatment facilities, one employing side-line equalization, and the other employing in-line equalization, were evaluated for impact on waste water characteristics, treatment process performance, and plant operating costs. Both equalization systems were highly effective in smoothing influent flow variations and providing a uniform flow rate to the process units. However, contrary to previous statements, each system exhibited only limited effectiveness in concentration leveling. A five percent BOD reduction was noted across the in-line basin. Overall removal of soluble phosphorous and effluent quality appeared to be unaffected by flow equalization.

*Waste water treatment, *Treatment facilities, Biochemical oxygen demand, Municipal wastes, Flow

*Flow equalization

E216
STATISTICAL DESIGN OF EQUALIZATION BASINS,

Di Toro, D. M.

Hydroscience, Incorporated,
Westwood, New Jersey.

Journal of the Environmental Engineering Division-ASCE, Vol. 101, No. EE6, p 917-933, December, 1975. 12 fig, 1 tab, 10 ref.

The major design problem in smoothing out fluctuations of concentration and mass flow rate in an equalization basin is to relate the characteristics of the fluctuating influent to those of the equalized effluent, as a function of the detention time. Presented here are the results and conclusion of two types of characterizations of the influent in graphical and tabular form suitable for design purposes. An analysis presented in subsequent sections addresses the questions of what are the statistics of the effluent concentration and effluent mass flow rate, and what is the probability that the effluent concentration exceeds a given design value. It is concluded that the equalization basin is a device that can be used to control variability in much the same way that conventional treatment units control mean values. As a post-treatment device, an equalization basin may be designed to meet variability criteria that would be difficult to achieve in the reactive units of the system.

*Design criteria, *Statistical analysis, *Flow rates, Waste water treatment

*Equalization basins

E217
PROPORTIONAL DILUTER FOR EFFLUENT BIOASSAYS,

Riley, C. W.

Water Resources Commission,
Lansing, Michigan,
Michigan Department of Natural Resources.

Journal Water Pollution Control Federation, Vol. 47, No. 11, p 2620-2626, November, 1975. 5 fig, 1 tab, 3 ref.

The Wuerthele and Riley proportional diluter provides a uniform flow rate through all test containers and provides true isolated replicate test units. The diluter was designed to be used on site in determining the toxicity of complex waste water effluents to aquatic life. It operates by combining numerous effluent and diluent flows of equal volume to produce several different effluent test concentrations. The Wuerthele and Riley proportional diluter, constructed of 5-mm acrylic plastic sheeting, consists of three boxes stacked one on top of the other. A distribution box is on the bottom, a mixing box is in the middle, and a metered flow box is on top. The metered flow box is divided laterally into two separate chambers of equal volume for effluent and diluent. By maintaining the same levels in both chambers, 20 equal flows of both effluent and diluent are provided by the 40 hypodermic tubes placed through the bottom of the box. A constant head (90 mm) is maintained over the hypodermic tubes in each chamber by overflow chambers located at each end of the box. At a head of 90 mm, each of the 40 tubes delivers a mean flow of 285.9 ml/min to the mixing box below. The mixing box ensures the uniform concentration of each test solution. After mixing, the test solution drains through a combination overflow tube and delivery tube into one of nine compartments in the distribution box holding several test organisms. Eighteen bioassay containers are used in conjunction with the Wuerthele and Riley proportional diluter.

*Flow rates, *Waste water disposal, Aquatic life, Toxicity, Bioassays, Analytical techniques, Effluents, Pollutant identification

*Diluters

E218
METHOD FOR DETERMINATION OF DESIGN STORMS WITH LOCALLY NONUNIFORM DISTRIBUTION (VERFAHREN ZUR ERMITTLUNG EINES "BERECHNUNGSREGENS" MIT ORTLICH UNGLEICHMAESSIGER VERTEILUNG),

Sieker, F.

Wasserwirtschaft, Vol. 65, No. 11, p 293-296, 1975. 4 fig, 1 tab, 5 ref.

Applying multi-variable statistical variance analysis design storms with locally nonuniform distribution patterns can be developed. This analysis approach takes into account the stationary nonuniform rainfall-distribution due to orographic and topographic irregularities, the ratio between longitudinal and lateral expansion of rainfall areas as well as directional effects, the rainfall-occurrence-probability related to the average intensity of that rainfall, and causally nonattachable irregularities. The method is illustrated in this article by an example using daily precipitation curves.

*Precipitation (atmospheric), *Statistical methods, *Rainfall, Storm water, Mathematical models, Analytical techniques

Variance

E219
COMPUTERIZED MONTHLY REPORTS, COST-EFFECTIVE ALTERNATIVE?,

DiGiano, F. A., DuPuis, R. J., and Williams, P. J.

Massachusetts University,
Amherst,
Department of Civil Engineering.

Water and Sewage Works, Vol. 122, No. 12, p 49-53, December, 1975. 5 fig, 2 tab.

An optical scanning form and computer program, DTECTR (Diagnostic Testing of Efficiency by Computerization of Treatment Reports), have been developed to record, review, evaluate and store monthly operational data from waste water treatment plants. Operators at eight waste treatment plants in Massachusetts will soon participate in a pilot testing program of DTECTR. The computer program will evaluate plant operations rapidly, store data, make the operational data easily accessible to engineers and regulatory agencies, provide flexibility for expansion of data evaluations, and reduce staff time normally spent compiling such information. The system, developed by the University of Massachusetts Division of Water Pollution Control, includes an optical scanning form to be filled out by the plant operator. Space is provided for recording the following daily data: rain, flow, sludge recycle, dissolved oxygen, pH, chlorine residual, settleable solids, total coliform, fecal coliform, phosphorus and nitrogen in final effluent, suspended solids, BOD, and sludge settleability. Estimates of cost indicate that implementation of DTECTR by one state regulatory agency would result in a cost of $341 per month in contrast to $600 per month as required for present staff data analysis.

*Waste treatment, *Computers, Treatment facilities, Waste water treatment, Monitoring, Costs

Pilot tests, Cost-effectiveness

E220
MONOGRAPH FOR THE EFFECTIVENESS AND COST OF WATER TREATMENT PROCESSES FOR THE REMOVAL OF SPECIFIC CONTAMINANTS, VOLUME II, KWIK INDEX,

Watson, I. C., Spano, S. J., Davis, H. N., and Heider, F. M.

Environmental Planning and Engineering,
Division of David Volkert and Associates,
Bethesda, Maryland.

August, 1974. 83 p. PB 242 443.

Information is presented on treatment processes for potable water supplies and their costs. Volume II consists of a KWIK INDEX which provides additional references for more detailed information on treatments and costs. The purpose of the report is to be a general planning document to give the user general concepts on what treatment methods are available to remove specific contaminants or reduce them below the limits required or recommended by the 1974 Federal Drinking Water Standards and Guidelines. Physical, biological, chemical and radiological contaminants are covered. Cost estimate curves and procedures are outlined in Volume I. The KWIK INDEX in Volume II is divided into reference, subject and author sections. The reference section is organized numerically. The subject section lists subjects, titles and reference numbers which allow cross-referencing to the reference section. The author section lists principal authors and also refers to the reference section.

*Potable water, *Treatment, *Water treatment, *Waste water treatment, *Indexing, Bibliographies, Publications, Information exchange, Costs

KWIK INDEX

E221
BIOMASS DISTRIBUTION AND KINETICS OF BAFFLED LAGOONS,

Reynolds, J. H., Nielson, S. B., and Middlebrooks, E. J.

Journal of the Environmental Engineering Division-ASCE, Vol. 101, No. EE6, p 1005-1024, December, 1975. 6 fig, 9 tab, 25 ref.

Performance, biological responses, and kinetics of three baffled model waste stabilization ponds were compared to those of an unbaffled model waste stabilization pond to determine the effects of baffle configurations and increasing submerged surface area. Three kinetic models were developed: a first-order completely mixed flow model, a model with materials balances and completely mixed flow, and a first-order growth model with a plug-flow reactor configuration. The submerged surface areas of the baffled ponds were equal and the environmental factors affecting pond performance were identical for all ponds. The ponds were illuminated with fluorescent lights and fed a synthetic waste. Performance and biological responses were monitored during several different detention times. Results of monitoring and analyses of the ponds' various elements are given in tables and graphs. A dense layer of scum on the surface of the model pond liquid apparently increases odorous gases emitted from the pond, decreases the kinetic rate of biodegradation, decreases the pH, and decreases the amount of suspended solids. At a detention time of 15 days there was little difference among the pond configurations in the amount of organic carbon removal, but at a detention time of 1.5 days the difference was between 53% and 70%. Biological degradation rates were significantly higher in the baffled ponds than in the control pond, with the longitudinal baffle configuration providing the highest rate of reduction of soluble organic carbon concentrations.

*Kinetics, *Lagoons, *Model studies, Biological treatment, Biodegradation, Monitoring, Suspended solids

Biomass distributions, Baffled waste stabilization ponds

E222
TECHNICAL-ECONOMIC PRODUCT DESIGN AS TYPIFIED BY A SEWAGE PUMPING INSTALLATION,

Arn, E., Schaer, F., and Trachsel, A.

Sulzer Technical Review, Vol. 57, No. 3, p 169-176, 1975. 9 fig, 7 tab, 6 ref.

A sewage pumping installation has been used as an example to describe the overall development of integrated technical-economic design and manufacture of engineering products. Waste water pumps are required to transfer domestic and industrial effluents, which have been collected in ponds, to a sewage treatment plant. In this case, public concern about sewage pumps has stressed the danger of clogging, and the need for high reliability, quiet operation, and an odor-free system. The four concerns--uncloggability, smell propagation, noise propagation, and motor reliability--were considered as one type of assessment criterion and were evaluated according to technical values. Other assessement criteria--excavation, concreting, maintenance, pipework and fittings, and installation work--were rated in terms of economic values. Operating data, including flow, pressure increase, speed, efficiency, and pump drive input were also compared. Basic sketches of positive displacement, fluid flow, and other types of pumps were prepared. By combining solution principles to achieve an overall function, procedures may be decided. With the aid of a value analysis technique, the technical and economic optimal pumping system may then be selected.

*Sewage treatment, *Pumps, *Economics, Sewage lagoons, Equipment, Engineering, Operation, Maintenance, Design criteria, Planning

Value analysis

E223
EFFECT OF THE OPERATIONAL TEMPERATURE IN REVERSE OSMOSIS METHOD (Gyaku shinto ho ni okeru sosa ondo no eikyo),

Kitao, K., Sugawara, M., and Ozaki, H.

Preprint, Japan Society of Civil Engineers, Tokyo, p 532-533, 1975. 7 fig.

The effect of temperature on the permeability of solvents and solutes in reverse osmosis was studied, using an acetylcellulose membrane. The solvents studied were pure water, methyl alcohol, ethyl alcohol, and n-propyl alcohol, while the solutes studied were NaCl, HgCl2, and three surfactants in aqueous solution, all with a solute concentration of less than 10 mmoles. Permeability was varied by changing the pressure between 0.5 and 50 kg/sq cm and the temperature between 3 and 31.5 C. At a constant pressure and temperature, the membrane permeability (K) decreased with the increased viscosity of the solvents. With variable temperatures, the membrane permeability was inversely proportional to the change in the viscosity of the given solvent at a given temperature, and the product between its K value and viscosity was nearly constant. For the solute in an aqueous system, there was a linear relationship between the solute permeation rate and the solution permeation rate for a constant temperature. The slope of the line became more steep when the higher temperature was used, which indicated that the adsorbed amount of solute within the membrane increased with lower temperature. The solute permeation rate increased more rapidly by changing temperature than by changing pressure even when the same solution permeation rate was obtained.

*Reverse osmosis, *Membrane processes, *Temperature, *Pressure, Viscosity, Permeability, Solvents, Solutes, Surfactants, Analytical techniques

E224
HOW DOES TANK GEOMETRY AFFECT THE OXYGEN TRANSFER RATE OF MECHANICAL SURFACE AERATORS?,

Kormanik, R.

Envirex,
Waukesha, Wisconsin,
Water Quality Control Division.

Water and Sewage Works, Vol. 123, No. 1, p 64-67, January, 1976.

To determine the influence of test basin geometry on the oxygen transfer capabilities of mechanical surface aerators, tests of three types of surface aerators were conducted in six geometric test tank configurations. The three types of aerators tested were the high speed-high trajectory, high speed-low trajectory, and a low speed bridge mounted unit. The test basin geometry was varied by using an 80 ft by 80 ft by 20 ft deep tank and partitioning it into quarter and half sizes. The aerators were tested at 12 ft and 18 ft depths at 15, 30, 50, and 75 HP speeds. The oxygen transfer rate of a surface mechanical aerator at standard conditions was not affected by the water depth of the test basin. The correlation between oxygen transfer rate and basin surface area was much closer than the correlation between oxygen transfer rate and basin volume. Because of this finding, it was recommended that when a standard transfer rate is quoted, the associated value of surface area should also be indicated. For high speed aerators, the lower the aerator horsepower, the greater the influence of basin geometry. The oxygen transfer rate of the low speed aerators at standard conditions was far less affected by basin geometry than that of the high speed type.

*Oxygen, *Aeration, *Equipment, Tanks, Laboratory tests, Analytical techniques, Data collection

Oxygen transfer rates, Basin geometry, Aerator speeds

620

E225
AUTOMATED DILUTION FOR MEASUREMENT OF NITRATE IN WATER,

Goulden, P. D., and Kakar, Y. P.

Canada Centre for Inland Waters,
Burlington, Ontario, Canada.

Analytical Letters, Vol. 8, No. 10, p 763-768, 1975. 1 fig, 2 tab, 3 ref.

Multiple dilutions on an AutoAnalyzer up to a 1200:1 ratio were performed to analyze nitrate levels in water over the range 2 micrograms/liter to 250 mg/liter nitrogen. The manifold used contained two pumps, one for the first two dilutions and one for the actual nitrate determination. The effects of dilution ratios in a single dilution step were determined and repeated twice to test for reproducibility of the sampling process. A major source of loss of integrity was found to be the debubbling and resampling process. A variety of natural water samples and sewage effluents were analyzed for nitrate by addition at the approximate manifold addition point. The precision of the analysis was determined by analyzing natural water samples and determining the coefficients of variation. It was found that the coefficients of variation over the dilution ranges were not significantly different. The dilution technique is applicable to other analyses besides nitrate in the AutoAnalyzer.

*Analytical techniques, *Waste water (pollution), *Nitrates, Measurement, Pumps, Sewage effluents, Water analysis

*AutoAnalyzer

E226
AUTOMATED METHOD FOR THE DETERMINATION OF TOTAL AND INORGANIC MERCURY IN WATER AND WASTEWATER SAMPLES,

El-Awady, A. A., Miller, R. B., and Carter, M. J.

United States Environmental Protection Agency,
Chicago, Illinois.

Analytical Chemistry, Vol. 48, No. 1, p 110-116, January, 1976. 4 fig, 7 tab, 21 ref.

An automated cold vapor method for analyzing a large number of mercury samples in water and waste water permits a reasonable number of samples to be analyzed in a day and is a suitable method for samples with a high content of particulate matter and oxidizable impurities. The detection limit of the method on the range 0-0.6 micrograms/liter is 0.05 micrograms/liter with a COD of less than 700 mg/liter. Different oxidizing agents for the digestion step are compared in tables. The results of the automated method are then compared with results from a manual method, demonstrating that there is no significant difference in the values obtained by the two methods. The automatic method is suitable for the separate determination of inorganic and organic mercury. The inorganic mercury is determined by removal of all reagents and the concentration is read off a calibration curve. It is then subtracted from the total mercury which was determined by normal digestion and reduction steps and read off a calibration curve. The difference is the amount of organic mercury present in the samples.

*Waste water (pollution), *Water analysis, *Mercury, *Pollutant identification, Automation, Chemical oxygen demand

E227
STREAM ANALYZERS ARE FOR WASTE AS WELL AS PRODUCT,

Klein, A.

Control Engineering, Vol. 22, No. 12, p 39-41, December, 1975. 5 fig.

The latest design and application trends in on-line analytical instruments are described. Two gas analyzers, both instruments designed to be tied in with control loops and computing elements to correct or trim a process, are the type OJ oxygen analyzer and the type UJ particulate monitor, designed by Bailey Meter. Beckman offers an air quality chromatograph that works better than infrared or flame ionization methods. Houston Atlas' hydrogen sulfide gas analyzer utilizes the specific reaction between lead acetate and H2S to form dark lead sulfide which is detected by a CdS photocell and differentiated to provide a dc signal. A Honeywell digital computer and a teletypewriter are teamed up with the old chromatograph system. Continuous on-line analytical service is also offered by L & N in process photometry, differential refractometry, and trace oxygen analysis. The Taylor Instrument Servomex OA-269 industrial flue gas oxygen analyzer can be used on flue or stack gases with a high concentration of condensable vapors at ambient temperatures. Among liquid analyzers is Delta's total carbon analyzer. It has a nephelometric detector that uses visible light and conventional optics to eliminate the need for filtered microliter sampling such as other detectors might require. Hach's automatic chlorine analyzer uses as a chlorine reagent an orthotolidine solution that is twice as strong as typical solutions. Milton Roy Company offers pH, conductivity, sodium ion, dissolved oxygen, and colorimetric analyzers. A closed loop fuel oil viscosity control system is the newest product of Newton, Massachusetts.

*Instrumentation, *Analytical techniques, *Waste water treatment, *Pollutant identification, Automation, Computers

Analyzers, On-line technology

E228
ISOTOPIC AND QUANTITATIVE ANALYSIS OF THE MAJOR CARBON FRACTIONS IN NATURAL WATER SAMPLES,

Games, L. M., and Hayes, J. M.

Indiana University,
Bloomington,
Departments of Chemistry and Geology.

Analytical Chemistry, Vol. 48, No. 1, p 130-135, January, 1976. 4 fig, 5 tab, 36 ref.

The task of determining the physical and biological processes that govern the movement and degradation of carbon compounds in groundwater provoked the description of some analytical methods for determining the total carbon present in water in four discrete fractions. The fractions are inorganic carbon, volatile organic carbon, methane and carbon monoxide, and nonvolatile organic carbon. The inorganic fraction of carbon is collected by acidification of the water sample with H3PO4 and vacuum stripping of the resultant free CO2 which is then distilled, measured, and removed for isotopic analysis. The volatile organic fraction is comprised of organic material which can be stripped from the water at room temperature by purging with a stream of purified oxygen. The volatile organic material is oxidized in a combustion oven and the CO2 collected in a cold trap. An ultraviolet photooxidation technique converts nonvolatile organic carbon to CO2. Carbon dioxide samples are obtained by a modification of the volatile organic fraction procedure and after removal of water, inorganic carbon, and less volatile organic compounds, oxidation steps release methane and CO. Because some organic compounds other than methane may escape in one step of the previous procedure, another method traps all hydrocarbons other than methane on a bed of activated alumina. The techniques described permit the monitoring of all of the carbon present in groundwater, and provide subfractions of the total carbon that can be useful in delineating the processes leading to the precise composition of the water.

*Carbon, *Groundwater, Pollutant identification, Analytical techniques, Methane, Organic compounds

E229
THE EFFECT OF SOME CARBON SUBSTRATES ON MORPHOLOGY OF FLOCS AND QUANTITATIVE RELATIONS AMONG MICROORGANISMS IN ACTIVATED SLUDGE,

Bieszkiewicz, E., and Lapies, E.

Warsaw University, Poland,
Institute of Microbiology,
Department of Water and Sewage Microbiology.

Acta Microbiologica Polonica, Vol. 7, No. 1, p 55-59, 1975. 3 tab, 7 ref.

The effect of glucose, sodium acetate, and gallic acid substrates on microorganisms of activated sludge were studied. A synthetic activated sludge was cultured in sewage for four weeks and samples were removed every three days. Each sample was measured for the number and size of flocs; for the number of flagellata and the number of free-living, creeping, and settled ciliata by the direct count method and the plate method; for volume index; and for oxygen demand. Great differences were found in the appearance, size, and number of flocs of the activated sludge cultures. In the sludge cultured with sodium acetate, the flocs were ramified. In the culture with glucose, the flocs were irregular and had folded margins and fine-grain structure. In the gallic acid culture, the flocs were of a similar appearance but were much smaller and twice as numerous. A greater number of bacteria were aggregated in the acetate and glucose sewages than in the gallic acid sewage. The number of free-living bacteria declined in the acetate sewage, but remained constant in the glucose sewage. In the gallic acid culture the number of free-living bacteria was greater than that of the aggregated organisms for the whole period of experiment. Flagellata, which developed in the early part of the experiment, decreased as settled ciliata increased. Purification of the glucose sewage reached 76%, that containing sodium acetate, 87%, and that containing gallic acid, 61%.

*Activated sludge, *Sewage, *Waste water treatment, Microorganisms, Bacteria, Measurement, Analytical techniques

Carbon substrates, Glucose, Sodium acetate, Gallic acid, Flocs

E230
NITROSOPHENOL AND NITROSONAPHTHOL DERIVATIVES AS REAGENTS FOR SPECTROPHOTOMETRIC DETERMINATION OF IRON AND DETERMINATION OF MICRO-AMOUNTS IN WATERS WITH 2-NITROSO-5-DIMETHYLAMINOPHENOL,

Toei, K., Motomizu, S., and Korenaga, T.

Okayama University,
Tsushima, Okayama-shi, Japan,
Department of Chemistry.

The Analyst, Vol. 100, No. 1194, p 629-636, September, 1975. 5 tab, 38 ref.

The iron(II) complexes of twenty-five nitroso compounds were examined spectrophotometrically in aqueous solution for suitability as analytical reagents for iron(II) ion. Although most of the complexes with nitroso compounds had a 1:3 composition in aqueous solution and chloroform, two complexes, nitroso-DMAP and nitroso-DEAP, had a 1:4 composition. Because of this, and because the ligands possess strong electron-donating groups, the molar absorptivities of the two complexes were very large. Although the molar absorptivity of the nitroso-DEAP complex was slightly larger than that of the nitroso-DMAP complex, the latter is more useful for the determination of micro-amounts of iron. Nitroso-DMAP is more stable, and the color of its complex with iron(II) in aqueous solution is stable for much longer than nitroso-DEAP. A spectrophotometric method using nitroso-DMAP was applied to the determination of iron in city and river waters. The method possessed several advantages. The complex formed had a molar absorptivity about four times as large as that formed with 1,10-phenanthroline. Diverse ions which are generally present in natural waters did not interfere in the determination. The nitroso-DMAP complex had a wide range of pH in which the full color developed, and the simplicity of the procedure allowed measurements to be carried out in aqueous solution.

*Spectrophotometry, *Analytical techniques, *Nitrogen compounds, Iron, Pollutant identification, Rivers

Nitroso compounds

E231
CADMIUM AND ZINC CONTENTS OF CORN LEAF AND GRAIN PRODUCED BY SLUDGE-AMENDED SOIL,

Jones, R. L., Hinesly, T. D., Ziegler, E. L., and Tyler, J. J.

Illinois University,
Urbana-Champaign,
Department of Agronomy.

Journal of Environmental Quality, Vol. 4, No. 4, p 509-514, October/December, 1975. 5 fig, 3 tab, 10 ref.

Because the cadmium present in sludge-amended soil presents a hazard to plant and animal ecosystems, the patterns of concentrations of cadmium in plants have been related to soil pH. In animal and plant physiology, zinc is important to consideration of transport of cadmium across membranes, and levels of zinc in plant tissues were also reported. Sludge from high-rate anaerobic digestors was applied to three out of four plots of corn. Leaves and grains of the corn were sampled, and yield determinations were made. In addition, soil samples were taken. Cadmium and zinc were determined in the samples by atomic absorption analysis. The pH was determined from the soil samples in distilled water solutions. Decline in yield was the first apparent effect of some elemental excess. Increases in extractable cadmium and zinc from the sludge-amended soils was also a result. Uptake of cadmium was substantial in the case of leaves. Mechanisms appeared to operate in diminishing the concentration of cadmium in grains. Zinc contents resembled results for cadmium. Soil pH was found to interact significantly with cadmium levels in the soil to affect cadmium levels in the leaves. The interaction between pH and zinc has long been known. An important new observation was that above pH 7 when large amount of zinc were available, increases in cadmium levels in leaves were not observed. Substantial increases in zinc content could undoubtedly mediate any negative effects of sludge-enhanced cadmium levels. Furthermore, sludges that would be applied to plants for nutrients would be applied in considerably smaller amounts.

*Cadmium, *Zinc, *Sludge treatment, *Soil analysis, Hydrogen ion concentrations, Sludge disposal, Pollutant identification, Environmental effects, Anaerobic digestion

Land application, Atomic absorption analysis

E232
QUALITY OF WATER DISCHARGED FROM AN URBAN MOTORWAY,

Hedley, G., and Lockley, J. C.

Severn-Trent Water Authority,
Severn-Trent, England.

Water Pollution Control, Vol. 74, No. 6, p 659-674, 1975. 13 fig, 4 tab, 8 ref.

As a result of the increased awareness of pollution loading from storm run-off, a study was made of the pollution emanating from a heavily trafficked seven-lane road over a twelve-month period. Rainfall measurements were taken and samples of storm run-off were taken from every storm. The samples were analyzed for determination of iron, copper, zinc, lead, nickel, chromium, and chlorion. Pollution loading was significantly higher during the winter, largely due to salting which contributes not only to pollutants but also to corrosion. Approximately 160 tons of material is removed annually from the 800-meter-long road surface under study. In addition, it was estimated that the average loading of solids in the run-off is about one ton per month. The major metallic contributor to the loading was zinc, probably due to wear on tires. The presence of chlorion is also attributed to salting, but it was significant because it appears to affect the concentration of other pollutants. Iron was attributed to exhaust emission, tire wear, oils and greases, corrosion, and break-down of road surface, corrosion of the motor vehicle being the greatest contributor. The total loading of lead was not as high as was expected, but this could be explained by a wind factor. Copper, nickel, and chromium were present in minute quantities that also peaked during the winter months due to salting. It became apparent from the studies that two issues must be considered: whether the justification of "keeping the highway open" is worth the heavy pollution and corrosion caused by heavy salting, and whether the policy of discharge without treatment of road run-off is responsible.

*Storm runoff, *Rainfall, *Analytical techniques, Heavy metals, Urban runoff, Zinc, Waste treatment, Water pollution control, Environmental effects

Pollution loading

E233
DETERGENT PHOSPHATE BAN YIELDS LITTLE PHOSPHORUS REDUCTION, PART II,

Etzel, J. E., Bell, J. M., Lindermann, E. G., and Lancelot, C. J.

Purdue University,
Lafayette, Indiana,
Department of Environmental Engineering.

Water and Sewage Works, Vol. 122, No. 10, p 91-93, October, 1975. 8 fig, 6 tab.

The legislative ban in Indiana on detergent phosphates has failed to reduce the remaining stream phosphorus to levels low enough to be of any biological significance in reducing the potential for algal growth. Results of a 1974 study show that despite the existence of the statewide ban for 1.5 years, mean total-P concentrations are 110 to over 2000 ppb throughout the studied rivers. This is considerably higher than the 10 to 50 ppb generally considered to be the range in which phosphorus can limit excessive algal growth. Laboratory bioassays all failed to show a positive growth response to phosphorus spiking. No correlation was found between total phosphorus levels and observed fertilities in the studied rivers. Data for specific sections of rivers studied are given in tables. It has been found, however, that nutrients can be reduced from sewage treatment plant discharge through flocculation.

*Legislation, *Detergents, *Phosphates, *Phosphorus, Waste disposal, Eutrophication, Bioassay, Indiana, Rivers, Nutrient removal, Sewage disposal, Sewage treatment

E234
CHLORINATION IN DILUTE AQUEOUS SYSTEMS; 2,4,6-TRICHLOROPHENOL,

Smith, J. G., Lee, S., and Netzer, A.

Waterloo University,
Waterloo, Ontario, Canada,
Department of Chemistry.

Environmental Letters, Vol. 10, No. 1, p 47-52, 1975. 1 tab, 10 ref.

In order to elucidate the effects of chloroform on phenols, 2,4,6-trichlorophenol in dilute aqueous solution was treated with hypochlorous acid at pH 3.5 to pH 6. Reaction products were extracted from solution and examined by thin layer chromatography. The individual isolated components were characterized by their infra-red, nmr, and mass spectra. The principal products of the reaction were 2,4,4,6-tetrachloro-2,5-cyclohexadienone (A), and 2,6-dichloro-p-benzoquinone (B). Their identification was based on their spectra and was confirmed by mixture melting point with authentic samples. The possibility of the interconversion of A and B was investigated by treating each of these compounds with hypochlorous acid, but it did not occur. Instead, an unindentified material characterized by a carbonyl frequency at 1800 c/m was formed. A number of minor products were also formed. The material balance in the experiments was low, with approximately 50% of the organic material remaining in the aqueous layer or being lost by volatilization. Recovery of the organic products from the chromatographic column was also low. In part, this loss appears due to photolytically induced decomposition of the chlorinated products. Hypochlorous acid produces non-phenolic products by oxidation and by the addition of chlorine and/or hypochlorous acid to the aromatic ring. Although the toxicological properties of these polychlorinated species are unknown, chemical separations of chlorination reaction products should be employed with caution.

*Chlorination, *Chemical reactions, *Phenols, Analytical techniques, Pollutant identification

E235
SIGNIFICANCE OF TRACE METALS AND NITRATES IN SLUDGE SOILS,

Brown, R. E.

Environmental Protection Agency,
Columbus, Ohio,
Division of Waste Management and Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 12, p 2863-2875, December, 1975. 3 fig, 7 tab, 39 ref.

There is substantial potential for damage to the productivity of soils that are fertilized with waste water sludge, if no restrictions are made on the metal and nitrogen accumulations in the soil. A comparison of sludge-amended soils and soils that received no sludge showed that extractable zinc increased many times in sludge-amended soils. In addition, almost all of the applied zinc remained in an extractable form, thus presumably more available for plant uptake than metals in soils that have not received sludge. One report attributed crop damage in 24 cases to application of sludge. Another report showed that sludge applications that increased zinc by approximately 340 lb/acre produced no metal toxicity in corn grown on the site. Although data are not available to evaluate long-term effects of metals in sludge, it is generally agreed that, on a short-term basis, the addition of metal salts to soils without sludge would be more likely to cause metal toxicity conditions in plants than would an equivalent amount of metal from waste water sludge. Concerning nitrate pollution, there is no question of the fact that nitrate content of drainage waters from a sludge disposal site would be excessively high if no restrictions were placed on application. Dilution of the drainage water by groundwater or receiving water could minimize the hazard. In the case of sludge application to crop soils, the nitrogen application must equal the sum of gaseous nitrogen losses and the nitrogen requirement of the crop. Any excess would become a hazard in leachate groundwater. Because of the many variables, amounts of nitrogenous sludge applicable to soils should be determined on a site-by-site basis.

*Trace elements, *Soil analysis, *Heavy metals, *Zinc, Toxicity, Sludge disposal, Fertilization, Metals, Nitrates, Environmental effects

Land application

E236
CHEMICAL ANALYSIS AND ENVIRONMENTAL QUALITY,

Egan, H.

Chemistry and Industry, No. 19, p 814-820, October 4, 1975. 44 ref.

Chemical analysis can provide a measurement of the various factors which need to be taken into account in evaluating environmental quality. It can measure the level of substances, usually trace substances, which intrude in the atmospheric, aquatic or terrestrial environment, and can contribute to an understanding of the possible interaction between these factors. This article discusses various chemical monitoring methods: electro-optic devices based on ultraviolet absorption for measuring sulfur dioxide; a flame-photometric detector for sulfur compounds; infrared gas analysis and chemical reaction for measuring carbon monoxide; and, lasers for monitoring ozone, ethylene and other trace constituents in the atmosphere. Analytical methods for monitoring pollutants in aquatic environments include atomic absorption, atomic fluorescence, atomic emission and mass spectrometry, and neutron activation analysis. Study of the terrestrial environment has brought about the development of new multidetection or multiresidue methods such as gas-liquid chromatographic multidetection. There is even a growing interest in the monitoring of the total environment by remote sensing techniques.

*Water analysis, *Analytical techniques, *Pollutant identification, Chemical analysis, Monitoring, Measurement, Water quality

E237
A FEW CONSIDERATIONS ON THE MEASUREMENT OF PORE SIZE DISTRIBUTION OF ACTIVATED CARBON (Kasseitan no saikokei bunpu sokutei ni kansuru 2,3 no kosatsu),

Sato, S., Najima, K., Yoshikawa, K., and Inagaki, Y.

Mitsubishi Juko Giho, Vol. 12, No. 5, p 535-542, 1975. 14 fig, 5 tab, 12 ref.

Increasingly stringent pollution control standards and the demand for the reuse of water have increased the use of activated carbon for waste water treatment. A study of the microstructure of activated carbon is important since the microstructure is closely related to the adsorbing performance of the carbon. The nitrogen adsorption method and the mercury pressure-penetration method were used to study the microstructure of activated carbon. The accuracies of these methods and analytical procedures are discussed. Measuring techniques for specific surface area, pore volume, and pore size distribution were established. Results from the investigations of the pore size distribution of activated carbon used for water treatment have shown that these analytical techniques can be used as important evaluating means for virgin carbon, spent carbon, and regenerated carbon.

*Waste water treatment, *Analytical techniques, *Activated carbon, Water treatment, Adsorption

Pore size distribution, Activated carbon microstructure

E238
MEASUREMENT IN WATER RESEARCH: PART 1,

Measurement and Control, Vol. 8, No. 11, p 440-441, November, 1975. 1 fig.

The Water Research Centre, Buckinghamshire, U. K., is responsible for all aspects of water supply and disposal including resources, potable water treatment, quality, and distribution, sewage treatment, industrial wastes treatment, water pollution, and sewerage. Some of the techniques used at the WRC to identify pollutants are described. A gas chromatography/mass spectrometer is used to measure organic compounds such as oils, plastics, and pesticides. Although glass capillary columns have many advantages over the stainless steel columns usually used in hydrocarbon analysis, the experimental difficulties associated with their preparation and their limited commercial availability have inhibited their use. The WRC is investigating the application of some newer types of glass columns for research and routine work in water analysis. High-pressure liquid chromatography permits materials at low concentrations to be determined relatively easily. The WRC is evaluating a flameless atomic absorption spectrometry technique for the determination of trace metals. Anodic stripping voltammetry is an electroanalytical technique for the determination of trace metals; it has been used for the analysis of potable water, seawater, and sewage and sewage effluents. Emission spectrographic analyses were performed on water samples from rivers in England and Wales to determine the baseline concentrations of trace metals in these rivers.

*Water analysis, *Pollutant identification, *Analytical techniques, Heavy metals, Equipment, Instrumentation

Water Research Centre (U.K.)

F001
MONITORING: AN ENVIRONMENTAL STATE ESTIMATION PROBLEM,

Brewer, J W., and Moore, S. F.

California University, Davis, California

Journal of Dynamic Systems, Measurement, and Control, Vol. 96, No. 3, p 363-365, September, 1974. 1 fig, 1 tab, 12 ref.

A water quality monitoring system is needed by todays society. The authors have defined a monitor as an estimator which minimizes the cost of taking measurements and which simultaneously meets constraints on accuracy. The development of a monitor theory will improve environmental technological system design. Monitor synthesis can be divided into two subproblems. The design problem consists of selecting the variables for measurement, selecting the measurement devices, and selecting the spatial distribution of the devices. The management problem consists of choosing, on line, the type and sequencing of measurements. A simulated application of filter theory to the management of a water quality monitor is presented. It is shown that a suboptimal minimum cost monitor can be synthesized by the proper sequencing of costly measurements. However, optimum modeling continues to be a problem of much theoretical interest which requires more investigation.

*Model studies, *Monitoring, *Water quality control, *Mathematical models, Environmental conditions, Water quality, Standards, Performance, Regulation, Reliability

Monitoring system design

F002
WATERWAY MONITORING SYSTEM,

Mechanical Engineering, Vol. 96, No. 8, p 52-53, August, 1974. 1 fig.

In Belgium the first computerized waterway network monitoring system in Europe began operation. It is an electronic installation, utilizing a Siemens 305 process computer, and is to be further developed to surpass pure monitoring functions and to calculate in advance the levels in locks and dams to automatically ensure efficient water distribution for all rivers and canals in Belgium. The completed installation is expected to cost 25 to 30 million DM. Presently, 240 level-measuring stations are connected by an electronic remote-control system to make up the waterways installation. Information is transmitted by a Z 701 time-division multiplex remote supervisery control system operating by pulse-code modulation. The amount of water in the rivers and canals and the different discharges and outflows can be monitored continually. A mathematical model will work in conjunction with the process computer so as to control the dams in the rivers for flood prevention during high water, and shortage during low water. The influence of precipitation in the model of the dynamic river behavior will help to forecast and control dams. At Roselies on the Sambre qualitative studies are planned for an environmental instrument station, measuring water temperature, conductivity corresponding to salt content, pH value, redox potential, COD value (chemical oxygen demand), turbidity, and solar irradiation.

*Computers, *Monitoring, *Control systems, *Water management, Mathematical models, Rivers, Canals, Inflow, Tidal flow, Oxidation-reduction potential, Conductivity, Chemical oxygen demand, Turbidity, Solar radiation

*Waterway monitoring system, *Siemens 305 process computer

F003
FORECASTING WATERSHED POLLUTION USING A MODEL,

Mucciardi, A. N.

Adaptronics, Incorporated, McLean, Virginia

Water and Sewage Works, Vol. 121, No. 8, p 58-59, August, 1974. 2 fig, 8 ref.

A model for forecasting the pollutants in watersheds is explained that overcomes the difficulties experienced with conventional analytical models. The technology in Adaptive Trainable (Learning) Networks places no reliance on prior assumptions; the modeling can provide solutions from a very limited data base; and, the methodology provides accurate forecasts many times farther into the future than previously realized. The Adaptive Trainable Network modeling techniques were used to forecast the total bacteriophage concentration in the Potomac River as a function simply of environmental variables such as river flow rate, river staging, tide levels, precipitation, and average daily temperature. Four ALN forecasting models were constructed: 3-day forecast; 6-day forecast; 9-day forecast; and, 12-day forecast. The networks were able to make forecasts with an average accuracy of 95.2% throughout a 12-day forecasting period. The key to developing nonlinear multivariate forecasting models is the ability to train an adaptive learning network model. The ALN modeling procedure not only determines the proper linear and nonlinear structure of the model, but also the relevant or most discriminatory variables are identified. The subset of relevant variables is ranked with respect to discriminatory ability as a byproduct of the ALN training exercise. An explanation of how to develop the model as well as the description of the Potomac River exercise is given.

*Model studies, Watersheds (basins), Pollutants, Water pollution, Bacteriophage, Coliforms, Forecasting

*Adaptive Trainable Network, *Pollutant forecasting, Non-linear multivariate forecasting model

F004
BENTHAL DECOMPOSITION OF ADSORBED OCTADECANE,

Allen, H. L.

Rutgers University,
New Brunswick, New Jersey

Dissertation Abstracts International B, Vol. 35, No. 6, p 2802, December, 1974.

An experimental flowing stream system was designed to test the environmental impact of octadecane, a significant component of crude oil. It is known that the long term adverse effects of oil pollution are primarily the destruction of the benthos by deposited oil and the reduction in dissolved oxygen concentration. The process involves both aerobic and anaerobic phases. This research attempted to characterize the behavior of a benthic deposit containing octadecane under varying conditions of seed concentration, flow rate, dissolved oxygen concentration, surface area, nutrient concentration, and salt concentration, and to determine rate controlling factors. Its objective was also to determine the relationship between the benthal decomposition of adsorbed octadecane and the overall oxygen uptake of the benthal deposit. It was found that: decomposition of suspended octadecane proceeds at a rate about 1/10 that of sewage; benthal oxygen uptake rate is a function of initial seed volatile concentration at the deposit surface; the effect of flow rate is partly attributed to the base activity of the deposits and partly to the adsorbed octadecane on the nature of the deposit-water interface; low nitrogen levels inhibit benthal oxygen uptake but low phosphorus levels do not; and both the benthal oxygen uptake rate at constant flow and the effect of flow rate on uptake rate are functions of the reciprocal surface area of confined deposits.

*Oil pollution, *Water pollution effects, *Dissolved oxygen, Benthos, Environmental effects, Models, Oil

*Octadecane

F005
ROUTINE SURVEILLANCE ALTERNATIVES FOR WATER QUALITY MANAGEMENT,

Ward, R. C.

Journal of the Water Pollution Control Federation, Vol. 46, No. 12, p 2645-2652, December, 1974. 18 ref.

Three techniques of routine surveillance for water quality management are reviewed: grab sampling, automatic monitoring, and remote sensing. While grab sampling has been the traditional method of water quality analysis, it has the limitations of being unable to detect rapidly changing water quality conditions, such as spills, and of being unable to identify the source of an extreme. There has also developed a need for data acquisition with a large spatial coverage. The answer in time coverage is automatic monitoring and in space coverage is remote sensing. For best sampling, all three techniques in combination are needed. Cost, personnel, and data needs are factors to be considered in augmenting a traditional grab sampling system with the other two techniques. Data needs are dependent upon the pollution control strategy used and the character of the stream, both natural and as affected by population and effluent discharges. The cost-effectiveness of each system as applied by Colorado State University for both detection of spills and routine monitoring of pollutants is discussed. Management programs must concentrate on planning for automatic monitoring and remote sensing relative to the needs and the goals of each individual agency.

*Water quality management, *Monitoring, Automation, Remote sensing, Sampling, Spills, Pollutants, Measurement, Costs, Personnel

*Automatic monitoring, *Grab sampling, Data needs, Cost-effectiveness

F006
MONITORING THE QUALITY OF SURFACE WATER,

Kroon, D. J., and Mengarelli, M. Q.

Philips Technical Review, Vol. 34, No. 5/6, p 113-122, 1974. 7 fig.

The design of a system for monitoring the quality of surface water is described. Ideally a combination of manual and automatic measurements is optimal. Such a system should provide prompt information about a number of simple physical and chemical parameters, relating to oxygen balance and eutrophication, concentrations of malodorous components, mineral oils, oil slicks, phenols, certain trace metals, and organic micropollutants. Monitoring systems in an automatic network may measure only one or two parameters or may measure a large number of parameters. The first type is best situated at discharge sites and at the boundaries of a monitored area for which a mathematical model has been composed. A central computer can then be programmed with this model and immediately warn of unusual pollutants and a dangerous situation further downstream. For example, should an oil spill occur, an analysis of floating oil, oil in emulsified form, as well as oil in dissolved form should be measured. Knowledge of the composition of the spill, its sulphur content, and presence of any trace metals (such as vanadium) makes it possible to often establish the origin of such a discharge. In addition, a third type of monitoring station should check the accuracy of the data obtained in measuring water quality. A water monitoring station developed by Philips is detailed, which operates along the river Lambro, near Milan, Italy.

*Surface water, *Monitoring, Water quality, Automation, Measurement, Eutrophication, Oil Spills, Computers, Mathematical models

F007
TV SYSTEM GIVES AUTOMATIC ALARM AS WELL AS VISUAL MONITORING OF AIR AND WATER POLLUTION,

Canadian Controls and Instrumentation, Vol. 13, No. 9, p. 32, September, 1974.

A television system to give visual monitoring of liquid effluents or stack emissions has been developed by Siemens. The system also provides an automatic alarm of sudden changes. An image is recorded on a compact TV camera and is displayed on a monitor electronically broken down into 3200 dots. Digitized data is sorted and compared with new data, and any discrepancies signal a visual and/or audible alarm. Three adjustable parameters can be set to select the pollution conditions at which an alarm is to be given. These are operating sensitivity, transient disturbance suppression, and sustained disturbance suppression. Monitoring takes place without interruption; operating sensitivity is high enough for a level of alteration of 30% on a coherent surface, corresponding to 0.1% of the television image to be detected. The system can be used for both air and water pollution monitoring. In liquid effluent monitoring, the Telemat system can monitor the degree of cleanliness of the effluent or it can be used with control fish tanks where an alarm occurs when fish die and rise to the tank surface due to their sensitivity to the quantity of the effluent.

*Monitoring, *Pollutant identification, Automation, Effluents, Remote sensing, Data collections, Liquids, Fish

Television system

F008
HOW MUCH "RELIABILITY" IS "ENOUGH"?

Linowiecki, A. G., and Lydick, J. D.

Offshore, Vol. 35, No. 2, p 240, 242-244, 247, February, 1975. 4 fig, 1 tab.

Costs and reliability of hydrocarbon pollution monitoring are discussed. Subsea well control and monitoring systems should help operators maximize hydrocarbon production with minimum total cost, consistent with safety and pollution control requirements. The methods detailed can be used for various types of equipment and systems and are useful in offshore and subsea applications which involve high costs of lost production and perhaps difficult maintenance. Mathematical relationships are shown for reliability of a pollution control system. The failure rate of a system may be determined by: design with appropriate stress margins; design verification for the specific application; and employment of proven procedures, trained experienced personnel, and discipline in organization. Control system costs are affected by ability to control the well, ability to provide useful and reliable information about well performance and operating conditions, pollution control capabilities, safety capabilities, and availability.

*Monitoring, *Costs, Water pollution control, Design criteria, Wells, Mathematical models, Systems, Oil

*Hydrocarbon pollution

F009
AN ECONOMIC MODEL OF WASTE OIL RECOVERY, REPROCESSING AND DISTRIBUTION SYSTEMS,

Martin, E. J., and McMillan, L.

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Incorporated, Washington, D. C., p 405-418. 4 fig, 4 tab.

A mathematical model for the economics of waste oil recovery and re-refining has been developed by the Maryland Waste Oil Recovery and Reuse Program. Called the Cost, Revenue, and Profit (CRP) Model, this model calculates the cost of recovery, re-refining and distribution of waste oils. Additionally, it calculates revenues generated by the sale of these products to determine profit or loss. Cost components include: initial investment for real estates, the re-refining plant, collection and distribution systems, and capital for project startup; annual operating cost of the system; annual cost of collection and distribution of oils; cost of insurance; the depreciation of the plant and capital equipment; and cost of operating and investment capital. The model employs interactive factors whereby alternative systems are possible, dependent upon impact. A description of not only costs but also the revenue section of the model is given. Measures such as operating profit, net profit, cash flow, and return on investment dollar indicate the economic viability of any given system.

*Model studies, *Mathematical models, *Costs, Waste disposal, Maryland, Operating costs, Capital costs, Profit

*Waste oil recovery, Re-refining

F010
EXPERIMENTAL STUDY OF INTERMITTENT PIPE FLOW USING PITOT-TUBE PROBES WITH HIGH FREQUENCY RESPONSE,

Meseth, J.

Archives of Mechanics, Vol. 26, No. 3, p 319-400, 1974. 9 fig, 5 ref.

Special Pitot-tube probes have been designed to measure pressure fluctuations of water flow up to a frequency of 1 kHz. A model was presented to interpret experimental observations on intermittent pipe flow up to a Reynolds-number of about 20,000. Disturbances were introduced by injections of a thin water jet at the pipe entrance over a short period of time. This resulted in a turbulent slug of pipe flow, which increases with time. The result was intermittent flow in the pipe without significant change in mean flow velocity. Measurements were then taken in the regions where the laminar flow was followed by turbulent flow and vice versa. In such regions, fluctuations in velocity are significantly larger than in a developed turbulent pipe flow.

*Pitot tubes, *Pressure, *Model studies, *Pressure measuring instruments, *Reynolds number, Measurement, Laminar flow, Turbulent flow, Pipe flow

*Flow velocity

F011
SEWAGE DISPOSAL AND WATER SUPPLY ALTERNATIVES ON THE BASIS OF WATER QUALITY AND ECONOMIC CRITERIA,

Rajagopal, R.

Michigan University,
Ann Arbor, Michigan

Dissertation Abstracts International B, Vol. 35, No. 5, p 2247, 1974.

Groundwater quality and economic factors as affected by sewage disposal and water supply alternatives for small rural townships in transition surrounding an urban center were studied. Water quality and cost data obtained from the surrounding townships in the Grand Traverse region of the State of Michigan formed the basis of this analysis. The major efforts divided into three parts as follows: a set of chemical measurements was statistically analyzed and models for nitrate-N in groundwater were developed on the basis of land use, soil and well characteristics; with the help of a sample survey, equations for individual and community sewage disposal and water supply construction costs were formulated; and the above models, along with equations for population growth and distribution, were programmed to form a general interactive computer information system. This information system provides cost of construction of individual and community sewage disposal and water supply facilities and average nitrate-N found in groundwaters for any choice of township, land use and population growth for any future time horizon.

*Sewage disposal, *Water supply, *Costs, *Groundwater, Michigan, Statistical analysis, Construction costs, Computer information, Model studies, Information retrieval

Economic factors

F012
ALGAE REMOVAL BY CHEMICAL COAGULATION,

Al-Layla, M. A., and Middlebrooks, E. J.

Water and Sewage Works, Vol. 121, No. 9, p 76-80, September, 1974. 9 fig, 2 tab, 12 ref.

Algae in surface waters and waste water stabilization pond effluents cause problems such as the shortening of filter runs in water purification plants, and clogging of distribution pipes and other water conduits. During the warm seasons, waste water stabilization pond effluents contain particularly high concentrations of algal cells which are discharged to a watercourse. These algae necessitate further treatment to meet newly legislated effluent guidelines. As a method of algal removal prior to discharge, chemical coagulation is proposed. This study investigated the effect of temperature on algal cell coagulation a variable which had not been previously analyzed. Interactions between five independent variables--temperature, alum dosage, mixed speed, flocculation time, and settling time--were mathematically studied. In an analysis of variance test, the most significant variable was alum dosage, followed by temperature, then flocculation time, paddle (mixing) speed, and settling time. Step-wise multiple regression analysis indicated the relationship between the percentage removal of algae and the other independent variables; a linear mathematical model was the most successful. Additional factors that might account for the effect of temperature on algae coagulation include the hydrophilic characteristics of algal colloidal material.

*Algae, *Surface waters, *Water purification, *Temperature, Regression analysis, Mathematical models, Chemical coagulation, Alum, Flocculation, Settling

Analysis of variance, Algal coagulation, Algal removal

F013
BOUNDARY LAYER SEPARATION CONCEPT OF SETTLING TANKS,

Chiu, Y.

George Washington University,
Washington, D. C.,
Department of Civil, Mechanical and Environmental Engineering

Journal of the Environmental Engineering Division, ASCE, Vol. 100, No. EE6, p 1213-1218, December, 1974. 1 fig, 2 ref.

An investigation of the inefficiency in sedimentation of using a circular tank as compared with a rectangular sedimentation tank was conducted. Theoretical flow characteristics of each type of settling tank were determined mathematically. Because of convenience of operation and other factors, more circular tanks than rectangular tanks have recently been used. However, it was demonstrated that separation will occur in the conventional horizontal-flow central-feed circular tank, but not in the rectangular tank. This separation results in eddy currents which reduce the efficiency in removal of settleable solids. The theoretical model for this type of circular tank showed that the liquid surface rises in its flow direction, and causes unstable flow, resulting in poor sedimentation.

*Separation, *Sedimentation, Mathematical models, Solids

Circular tanks, Rectangular tanks, Settling tanks

F014
RESERVOIR OPTIMIZATION FOR WATER QUALITY CONTROL,

Kaplan, E.

Pennsylvania University,
Philadelphia, Pennsylvania

Dissertation Abstracts International B, Vol. 35, No. 5, p 2232, 1974.

A constrained nonlinear optimization algorithm (COMET) and a program to simulate lake ecology (LAKECO) are used to control both the quantity and the quality of water within and discharged from a reservoir. A multiparameter water quality index was used as an objective function for optimization. Quality parameters included temperature, dissolved oxygen, 5-day BOD, pH, total dissolved solids, phosphates, nitrates, fecal coliforms, reservoir elevation, and discharge quantity. An application was given for a proposed reservoir where it was found that stringent design and legal requirements could be met for epilimnetic and discharged water during the period of simulation. The technique can also be used to provide both water quality and flood control capabilities to existing reservoirs capable of selective withdrawal.

*Algorithms, *Water quality control, *Reservoirs, Lakes, Water quality standards, Biochemical oxygen demand, Phosphates, Nitrates, Discharge (water), Flood control

Fecal coliforms

F015
STATISTICAL AIDS TO BACTERIOLOGICAL APPRAISAL OF EFFLUENTS. PART I--DIRECT COUNT METHOD,

Marais, G. v. R.,

The Civil Engineer in South Africa, Vol. 16, No. 7, p 227-237, July, 1974. 9 fig, 6 tab, 10 ref.

Bacteriological tests on sewage effluents have yielded variable results, due to both the method of determination and to the process itself. The variability must be understood in terms of statistical analysis. The two most commonly used methods for enumeration of microorganisms are the Most Probable Number method and the Direct Count method. The latter is detailed, in terms of statistical behavior. The properties of the Poisson distribution, its form, standard deviation, and the sum of two Poisson distributions are explained. Precision and accuracy of this method are examined. Observations were made as to confidence intervals. In application of the Direct Count method, both small field counts and large field counts are necessary, in order to assure a broad-based sample. In the cases where microorganisms grow in clumps, chains or clusters, a large field direct count assures the counting of the individual organisms in a given clump. Theoretical and experimental distributions for density of algal counts with clumping are given. This method has been chosen by many research engineers for use in measuring the bacteriological processes in rivers and in purification works.

*Statistical methods, *Sewage, Bacteria, Microorganisms, Rivers, Water purification, Effluents

*Sewage effluents, *Poisson, *Direct count method

F016
A MODEL FOR PREDICTING THE EFFECTS OF SEWAGE EFFLUENT ON WETLAND ECOSYSTEMS,

Dixon, K. R.

Michigan University,
Ann Arbor, Michigan

Dissertation Abstracts International B, Vol. 35, No. 5, p 2143-2144, 1974.

A mathematical model was formulated to forecast the effects of sewage waste water disposal on the ecosystem. The model consists of a set of ordinary, first-order linear differential equations which represent the mass balance of the biomass components of the system. The CSMP simulation language is used and operated on a digital computer. Sensitivity analyses for unit variables relating to waste water disposal such as water and nutrients were defined. Sensitivity was shown as the percentage change in the unit variable due to a 50 percent change in a parameter during a one-year simulation. For example, of the variables, it was shown that nutrients have a greater effect on litter decomposition than the amount of water covering the litter. Long-range stability of the model is useful for making decisions about the feasibility of using a particular wetland ecosystem for waste water disposal. Forecasts for an individual marsh ecosystem are possible when data are actually collected from the marsh study area. In this manner, parameters related to added water and nutrients can be varied to give the projected simulation.

*Marshes, *Ecosystems, *Mathematical models, *Sewage disposal, Environmental effects, Computers, Simulation models, Nutrients, Forecasting

F017
MODIFICATIONS TO THE EXECUTIVE COMPUTER PROGRAM FOR STEADY-STATE SIMULATION OF WASTEWATER TREATMENT FACILITIES,

Meier, P. M., and Fisette, G. R.

Curran Associates Incorporated,
Northampton, Massachusetts

N.T.I.S. Report No. PB 234-497. 59 p, 7 fig, 15 ref.

Documentation is given of an extended version of the executive computer program for the steady-state simulation of waste water treatment facilities. This was originally developed at the National Environmental Research Center of the Environmental Protection Agency at Cincinnati, Ohio. The research evaluated the feasibility of joint treatment of sewage and ground refuse at modified waste water treatment facilities. Major modifications of the computer program include an increase from 20 to 50 quality parameters, an increased capacity to accomodate 100 treatment processes and 200 streams rather than the original 25 processes and 25 streams, and an incorporation of the most recently developed cost functions, used for most of the unit processes. New mathematical models of advanced waste treatment processes were adapted for inclusion into the program. In addition, new subroutines were developed for a number of preliminary and sludge handling processes.

*Computers, *Treatment facilities, *Waste water treatment, Water quality control, Sludge, Simulation models, Streams, Costs, Mathematical models, Combined treatment

Environmental Protection Agency, Advanced waste treatment

F018
CONTROL SCHEMES FOR THE ACTIVATED-SLUDGE PROCESS,

Smith, R., and Eilers, R. G.

National Technical Information Service Report No. PB 236 086, August, 1974. 55 p, 19 fig, 34 ref.

A time-dependent computer model for the activated sludge process has been used to investigate potential advantages of a number of control schemes. The systems studied by this model include dissolved oxygen control, sludge wasting control, and sludge inventory control. The program input variables are given; quantitative benefits for control schemes are shown. The dissolved oxygen control installed in a typical 25-mgd (1.1 cu m/sec) municipal plant would reduce electrical power consumption for air supply by about 17 percent. If the blower is scheduled in a step pattern, about 11.5% of the electrical power might be conserved. However, the potential is minimal for reduction of dissolved BOD concentration in the effluent stream by means of food and microorganism control, using the final settler for sludge storage. Adequate relationships are lacking for the effectiveness of the final settler for separation of dissolved and suspended fractions of BOD.

*Computers, *Activated sludge, Dissolved oxygen, Settling, Separation, Municipal wastes, Control, Model studies

Sludge inventory control, Sludge wasting control

F019
WATER QUALITY MONITORING AND AQUATIC ORGANISMS: THE IMPORTANCE OF SPECIES IDENTIFICATION,

Resh, V. H., and Unzicker, J. D.

Ball State University, Muncie, Indiana, Department of Biology

Journal of the Water Pollution Control Federation, Vol. 47, No. 1, p 9-19, January, 1975. 1 tab, 70 ref.

Several methods which have been used to analyze the effects of human activities on aquatic environments are reviewed, including diversity indexes, the use of macroinvertebrates as indicator organisms, and the biotic index of Beck which is based on certain taxonomic groups as characteristic of clean water and others as characteristic of polluted water. The necessity of species identification in developing water quality criteria using indicator organisms is emphasized. Recommendations include greater cooperation between environmental consulting firms and academic personnel. The information compiled by a consulting firm will assist both the taxonomist and the ecologist in developing water quality criteria that may serve to enhance the understanding of water quality tolerances at the species level. There exists a need for increased support of investigations to develop identification keys and resolve basic life history problems of aquatic macroinvertebrates. Ecological agencies should support the programs of taxonomists by collecting data and producing publications. The time and effort now spent on identifying the specimen's genus and in developing long and often useless faunal lists for environmental impact statements should be shifted to associating immature and adult aquatic insects and to developing identification keys.

*Monitoring, *Indicators, *Water pollution control, *Water quality control, Water pollution abatement

*Species identification, Diversity index, Biotic index

F020
MASS TRANSFER TO NATURALLY FLOWING STREAMS,

Nadkarni, V. M., and Russell, T. W. F.

Delaware University,
Newark, Delaware,
Department of Chemical Engineering

Indian Engineering Chemical Process Design Development, Vol. 12, No. 4, p 414-416, 1973. 1 fig, 1 tab, 6 ref.

Before planning a system of waste water disposal to naturally flowing streams, it is necessary for a process design engineer to estimate rates of oxygen transfer which will occur. In 1964, a typical correlation was developed by Downing and Knowles to calculate the mass transfer coefficient. While their method was an empirical one, a simpler semiempirical correlation is presented which is simpler in form and is superior in its agreement with published data.

*Waste disposal, *Design engineering, Streams, Waste water treatment, Mathematical models, Calculations

Oxygen transfer rates

F021
WATER POLLUTION MONITORING SYSTEM,

Ikuta, S.

Kankyo Sozo, Vol. 5, No. 1, p 25, January, 1975. 3 fig.

A telemeter system to monitor the water quality in public drainages around the Tokyo area is described. Automated continuous monitoring results are reported to a central station from 20 stationary stations and three mobile units. Reported are water temperature, pH, turbidity, electro-conductivity, dissolved oxygen contents, chloride ion, cyanide ion, chromium +6 ion, total mercury, phenol, total organic carbons, sulfur, and oxidation reduction potential. Since the automated analytical techniques for the first six parameters are well established, they are reported by all stations. However the other measurements are selected by individual monitoring stations according to the difficulties in automated operation. The sampling and analysis at any station can be controlled from the central station. Seven additional stations are scheduled to be installed in 1974, and approximately 60 stations intend to participate in the water pollution monitoring system for the Tokyo area.

*Monitoring, *Water pollution, *Automation, Sampling, Analytical techniques, Models, Mercury, Phenols, Dissolved oxygen

Tokyo (Japan), Telemeter system

F022
A GENERAL LINEAR APPROACH TO STREAM WATER QUALITY MODELING,

Arbabi, M., and Elzinga, J.

IBM Corporation,
Gaithersburg, Maryland

Water Resources Research, Vol. 11, No. 2, p 191-196, April, 1975. 1 fig, 3 tab, 14 ref.

Techniques are presented for formulating stream water quality models which attempt to meet dissolved oxygen standards while optimizing some function of individual pollution abatement costs. New properties of the oxygen sag equation allow the constraint set of such mathematical programs to be described to a high degree of accuracy by linear inequalities. With the exception of upper and lower bounds on pollutant discharges, three linear constraints at most are required per reach. With simple constraint elimination techniques, the size of mathematical programs is reduced, making analysis of large-scale stream quality models feasible. It was concluded that for cases where the cost functions are linear or piece-wise linear convex, the analyst may utilize the power of linear programming and its ancillary methods of duality implications, sensitivity analysis, parameterization, chance constraint, and decomposition. For cases where cost functions are not linear or in which variables are discrete, the problem solution may be easier with the presence of linear constraints.

*Water quality, *Dissolved oxygen, *Mathematical models, Oxygen sag, Linear programing, Costs, Streams, Analytical techniques, Water quality control

Pollutant discharge

F023
A GEOMETRIC PROGRAMMING MODEL FOR OPTIMAL ALLOCATION OF STREAM DISSOLVED OXYGEN,

Ecker, J. G.

Management Science, Vol. 21, No. 6, p 658-668, February, 1975. 6 tab, 18 ref.

A geometric programming model was developed to allocate treatment requirements along a stream in order to meet stream dissolved oxygen standards at each point in the stream while at the same time to minimize the total cost of all discharging activity. Previous models have involved linear programming which consider total waste removal. In this nonlinear model, crucial variables are the removal rates of individual processes which act in series to form the treatment plant. Thus, both the actual design of the plants as well as the total removal rate determined by individual process removal rates are utilized. The basic use of the model is in determining the optimal operating levels for individual treatment processes in a fixed system design. Sensitivity analyses of changes in the characteristics of a stream and changes in stream standards are also conducted with this model. Stream standards are given in terms of a minimum allowable concentration of dissolved oxygen at each point in the reach. It is assumed that there are n discharge points and that the section between the ith and the i + 1st discharge point is termed the ith reach. Waste discharges are measured in terms of BOD. Treatment processes and associated total annual cost data are derived; waste treatment is calculated to improve the BOD level of discharge in order to decrease the DO deficit in a given stream. Applications of the nonlinear model to Upper Hudson River data are detailed. Alternative pollution abatement methods and their costs are also under investigation.

*Waste water treatment, *Dissolved oxygen, *Streams, Models, Discharge (water), Costs, Treatment facilities, Biochemical oxygen demand

*Geometric programming model, Nonlinear models, Stream standards

F024
COMPUTERIZED SEWER DESIGN: NEW TOOL FOR AN OLD PROBLEM,

Ewing, R. L.

Water and Sewage Works, Vol. 122, No. 4, p 67-69, April, 1975. 4 fig.

Computer utilization in design of civil engineering systems has led to more systematic approaches to problems, including comprehensive analysis of design parameters, cost data, and system configurations. The applicability of computer programs was demonstrated in the study of a relief sewer route for the city of Phoenix, Arizona. Input to the computer included ground profile data, sewage flows from a master-plant study, types of manholes, and hydraulic design criteria. The output from the computer supplied engineering documentation such as: upstream and downstream manhole numbers; pipe length; pipe diameter; slope; capacity flowing full; design flow; velocity at design flow; flow depth; invert elevation, downstream and upstream; ground elevation, downstream and upstream; and, depth to invert, upstream and downstream. When no obvious errors were noted, a plotted profile utilizing design data was drawn. Cost estimates of various unit cost matrices were computed. The completed report included a listing of pertinent design criteria, input data, system flows, system geometry, design output, quantity takeoff, cost summary by item, total project cost, and plotted design profile. Of four alternatives computed, the city of Phoenix evaluated actual design benefits and relative construction costs and authorized one of the designs. A pitfall of using computer generated disigns is that engineers must thoroughly check both input data and output results against good engineering judgment and must understand the limitations of the computer hardware and software itself.

*Computers, *Sewers, *Design criteria, *Civil engineering, Costs, Hydraulic engineering, Arizona, Construction costs, Analytical techniques

Plotted profile, Cost matrices, Sewer design

F025
WATER QUALITY ROUTING OF UNSTEADY RIVER FLOW BY FINITE ELEMENT METHOD,

Muraoka, K., and Nakatsuji, K.

Technology Reports of the Osaka University, Vol. 24, No. 1191-1129, p 827-845, October, 1974. 9 fig, 10 ref.

For the optimal management of waste discharge facilities, it is necessary to establish mathematical modeling of water quality routing of unsteady river flow. While flood routing and numerical analyses have been conducted, a large amount of error is introduced, particularly due to pseudo-dispersion caused by large space gradients of hydraulic quantities. In this case, the applicability of the Galerkin method is demonstrated. The method is based on finite element weighted residual methods and simulates a water quality problem using a diffusion-convection equation. Numerical errors are evaluated by means of an amplification factor as defined by Fourier analysis and are compared with those of several other finite difference methods. Computational efficiency of the Galerkin method is discussed, and application to a two-dimensional ideal model is considered.

*Discharge (water), *Mathematical models, *River flow, *Unsteady flow, Flood routing, Hydraulics, Simulation, Fourier analysis

Water quality routing, Diffusion-convection equation, Galerkin method

F026
CALIFORNIA PLANT GETS STRAIGHT 'A'S IN COMPUTER CONTROL,

Belick, F. M., and Van Kirk, F. N.

City of San Jose, California,
Water Pollution Control Division

Water and Wastes Engineering, Vol. 12, No. 3, p 20-24, 76-77, March, 1975.

The San Jose/Santa Clara, California, water pollution control plant has been converted from pneumatic analog control to direct digital control (DDC) with very little difficulty. Design and installation increased the plant capacity from 94 mgd to 160 mgd. Benefits of the DDC system include treatment efficiency, whereby process flow data is fed to the computer and updated every few seconds, achieving clean effluent discharge and flow balances within each unit process, and plant productivity, whereby most DDC control operations are in a central computer room and a larger (160 mgd) plant may be operated with no significant increase in personnel. Additionally, energy is conserved because automatic control of demand for air eliminates provision of excess air, as under a manual control system. Because the computer monitors loading rate of each tank and whether or not a particular one is in use, the flow of chemicals takes place only when they are needed, conserving the amount of chemicals. Moreover, the system has unlimited flexibility; changes in computer control are primarily changes only in software instructions, such as instrument ranges, alarm limits, or trend recording. With DDC, the plant management staff is continually provided with all types of operating information, pre-calculated and displayed graphically in appropriate engineering units, and accessible at a central location for use.

*Computers, *Water pollution control, California, Engineering design, Installation, Waste water treatment, Monitoring, Flow data, Analog computers, Personnel

*Direct digital control

F027
A DIMENSIONLESS DESIGN EQUATION FOR SEWAGE LAGOONS,

Larsen, T. B.

Dissertation Abstracts International B, Vol. 35, No. 9, p 4443, 1975.

A lagoon design equation was developed based on loading and climatic factors. This dimensionless equation for surface area was based on the results of a one-year study of a sewage lagoon. The year was divided into 296 sample periods; for each period data were collected on the chemical, biochemical, and climatic factors associated with the lagoon including biochemical oxygen demand, solar radiation, and wind speed. Stepwise regression analysis was used to determine predictive variables; after regression, the dimensionless products were seen as follows: MOT Number equals SURFACE AREA (SOLAR RADIATION) to the 1/3 power/INFLUENT FLOW RATE (INFLUENT BOD) to the 1/3 power; RED Number equals INFLUENT BOD minus EFFLUENT BOD/INFLUENT BOD; TTC Number equals WIND SPEED (INFLUENT BOD) to the 1/3 power/(SOLAR RADIATION) to the 1/3 power; TEMPR Number equals LAGOON LIQUID TEMPERATURE/AIR TEMPERATURE; and DRY Number equals RELATIVE HUMIDITY. The model design selected by a computer program for the estimation of non-linear parameters was: MOT = (2.47 to the RED power + 2.47 to the TTC power + 24.9/TEMPR + 150.0/DRY X 1,000,000. This equation is thus used to calculate the lagoon surface area needed to accomplish any desired BOD reduction (RED Number) given climatic data for the geographical area of a specific lagoon location.

*Models, *Equations, Lagoons, Sewage treatment, Biochemical oxygen demand, Climatic data, Statistical analysis, Computers, Regression analysis

*Dimensionless equations

F028
A COMPUTER COMES TO MISSOURI,

Plank, R. D.

Water Department,
City Utilities,
Springfield, Missouri

Water and Wastes Engineering, Vol. 12, No. 4, p 54-56, April, 1975.

Digital computers are now being utilized to monitor and control the Fulbright water plant at Springfield, Missouri. A Honeywell VupaK on-line data acquisition and process control system monitors 109 separate functions of the municipal treatment and distribution system. Data points measure the total raw water flow into the plant from a reservoir and a spring which is fed from lake watersheds. Three venturi flow devices transmit signals for these measurements. Analog measurements include reservoir, storage tank, and clearwell levels, raw and finished water pH, effluent turbidity at several points, air and finished water temperature, and station pressure. In addition, the computer monitors operation of six mixed-media and dual-media filters, and can initiate backwash from a loss-of-head signal or from effluent turbidity. Water quality is measured in a laboratory and manually entered into the computer in terms of residual chlorine, rising well level, inches of rainfall, chlorine tank weight, odor, color, bacteria, and conductivity. Monthly summaries of data on 79 points throughout the system are logged in. Items tabulated by the computer include total finished water, total wash water, total chemicals, and pump running times. This system has found flaws in the plant's previous measuring and control equipment. The operator need not have technical computer training, thus the system is easy for a water department to handle.

*Computers, *Monitoring, *Treatment facilities, *Waste water treatment, *Municipal water, Automation, Data analysis, Measurement, Filters

641

F029
IDENTIFICATION METHOD IN ENVIRONMENTAL SYSTEMS AND ITS APPLICATION TO WATER POLLUTION,

Ikeda, S., Miyamoto, S., and Sawaragi, Y.

Kyoto University,
Kyoto, Japan,
Department of Applied Mathematics and Physics

International Journal of Systems Science, Vol. 5, No. 8, p 707-723, 1974. 5 fig, 10 ref.

A non-well posed problem is discussed which arises in the identification of a pollution source distributed along a river from the observed data at the boundary on fixed points. The identification problem for the convective stream, after some transformation, results in solving the Fredholm integral equation of the first kind which is non-well posed. The solution does not continuously depend upon the observed data. By the application of a regularization method in numerical analysis, a stable algorithm is obtained to identify the distribution of a pollution source. For the dispersive case, the identification problem is also considered; simulation examples illustrate the applicability of this method to environmental control systems based either on the convective or on the dispersive phenomena.

*Mathematical models, *Water pollution, Simulation, Pollutant identification, Rivers, Streams, Analytical techniques

Fredholm integral equation, Environmental systems

F030
IDENTIFICATION OF PARAMETERS IN TRANSIENT WATER QUALITY MODELS FROM STOCHASTIC DATA,

Lizcano, J. J., Radha Krishnan, K. P., Fan, L. T., and Erickson, L. E.

Kansas State University,
Manhattan, Kansas,
Department of Chemical Engineering

Water, Air, and Soil Pollution, Vol. 3, No. 3, p 261-278, 1974. 5 fig, 11 tab, 19 ref.

An approach was presented for the identification of parameters in time-varying water quality models from stochastic data measured at two points along a stream (input-output type data). The models are plug flow models described by linear-first order partial differential equations. The time-lag phenomenon presented in these plug flow models is used to correlate the input-output data. This method is applicable for the development of water quality models of a stream affected by waste discharge. Good results were obtained when estimates of parameters were made by using two monitoring stations, thus giving a wide range of possible input conditions.

*Model studies, *Monitoring, *Stochastic hydrology, Water quality, Streams

*Plug flow models, *Waste discharge

F031
PLANNING AND OPERATION OF URBAN WATER QUALITY MANAGEMENT SYSTEMS,

El-Sahragty, M. M.

Dissertation Abstracts International B, Vol. 35, No. 5, p 2150-2151, 1974.

The effectiveness of a systems analysis framework for planning water pollution control systems is investigated. A dynamic programming model was used under deterministic and stochastic conditions; a water quality index was used to obtain optimal operating policy. A metropolitan economic-engineering urban water quality system was defined. Mathematical modeling and programming techniques are used to study interactions between physical, technological, economic, and social aspects of the problems of urban water quality management. A linear programming model was used for the definition of minimum required investment in the waste water control system and for the delineation of an optimal allocation of resources within this system. Additionally, computer simulation models are utilized for predicting effectiveness of the water pollution control system.

*Water pollution control, *Computers, *Systems analysis, Model studies, Simulation models, Water quality control, Water resources management, Urban water, Planning

F032
CALCULATION OF REACTION MECHANISMS IN FERMENTATION BASINS WITH CONTINUOUS FLOW (ZUR BERECHNING VON REAKTIONSABLAEUFEN IN KONTINUIERLICH DURCHSTROEMTEN FERMENTERBECKEN),

Adams, E., Boes, M., Hartmann, L., and Spreuer, H.

Wasserwirtschaft, Vol. 64, No. 10, p 294-301, 1974. 12 fig, 13 ref.

The performance and design of a biological sewage treatment facility with continuous flow is studied mathematically. The plant uses the fermentation process. Data processing and numerical mathematics do not yield reliable approximate solutions for the flows and chemical reactions. Rather, by using the theory of differential inequalities, with rigorous upper and lower bounds, an unknown exact solution of the system is determined. The dependency of the bounds on specific parameters is discussed.

*Sewage treatment, *Flow rates, *Biological treatment, Mathematical models, Equations, Fermentation, Treatment facilities, Design criteria

Germany

F033
BIOLOGICAL WASTEWATER TREATMENT MODEL BUILDING FITS AND MISFITS,

Boyle, W. C., and Berthouex, P. M.

Wisconsin University,
Madison, Wisconsin,
Department of Civil and Environmental Engineering

Biotechnology and Bioengineering, Vol. 16, No. 9, p 1139-1150, 1974. 6 fig, 3 tab, 43 ref.

During the past decade, statisticians have attempted to develop a uniform biological waste water treatment model which would aid in the design and operation of treatment facilities. A discussion of the validity of a single model is presented, including statistical problems in model parameter estimation and model discrimination. The physical process of fitting models usually precedes model building but parameter estimation processes are often overemphasized. Examples were given to illustrate that a model cannot be accepted simply because it fits the data. Goodness of fit is a necessary but not sufficient condition for acceptance of any model. When two or more conflicting models fit the data, it is necessary to give each model a chance to fail in order to verify a proposed model.

*Models, *Biological treatment, *Waste water treatment, Statistics, Model studies, Data collections

Model parameter estimation, Model discrimination

F034
MODELING MICROBIAL GROWTH IN WASTEWATER TREATMENT,

Hultman, B.

The Royal Institute of Technology,
Stockholm, Sweden,
Department of Water Chemistry

Journal of the Water Pollution Control Federation, Vol. 47, No. 4, p 843-850, April, 1975. 4 fig, 4 tab, 10 ref.

A model for bacterial growth was developed in order to choose suitable reactors for biological treatment of waste water. The growth equations for bacteria were considered to be: formation rate of living bacteria; formation rate of nonviable bacteria; utilization rate of substances necessary for cell synthesis; utilization rate of the energy source; utilization rate of the electron acceptor; and formation rate of a product. Bacteria may grow in suspensions, such as in the activated sludge process or anaerobic digesters, on inert contacting material such as trickling filters, rotating disks, contact aerators, or inert suspended solids, and on adsorbing materials such as activated carbon or clinoptilolite. Rate constants were determined using stoichiometric and thermodynamic theories. In this investigation, for the biological treatment of waste waters in Sweden, the most common biological treatment method is the activated sludge process, where bacteria grow in suspension. However, in some process combinations including postprecipitation or biological nitrogen reduction, bacterial growth on inert or adsorbing contact materials may be superior to that in suspended growth reactors.

*Bacteria, *Biological treatment, *Model studies, *Waste water treatment, Equations, Activated sludge

Bacterial growth

6044

F035
MONITORING MARINE OUTFALLS BY USING ULTRAVIOLET ABSORBANCE,

Balch, N., Brown, D., Pym, R., Marles, E., Ellis, D., and Littlepage, J.

Dobracky Seatech Limited,
Victoria, Canada

Journal of the Water Pollution Control Federation, Vol. 47, No. 1, p 195-202, January, 1975. 5 fig, 3 tab, 8 ref.

The applicability of using ultraviolet absorbance measurement to monitor the concentration of dissolved organic matter (DOM) in marine waste water outfalls was investigated. Two types of receiving waters were studied, both near Victoria, British Columbia. The first was the Clover Point outfall which discharges approximately 17 cu m/min of undiffused raw waste water at the low tide mark; the second was the Macaulay Point outfall which discharges approximately 14 cu m/min of comminuted effluent through a 6000 ft outfall ending in a 500 ft multiport diffuser at a depth of 200 ft. A scanning spectrophotometer was used to determine the most appropriate wavelength at which to measure absorbance, utilizing the spectra of various combinations of effluent, seawater, and distilled water. Routing measurements of several water quality parameters were monitored at offshore and shoreline stations. With increased discharge rates or at outfall locations at which the effluent field is least effectively diluted, it was indicated that the ultraviolet absorbance measurement technique is a simple, inexpensive, and effective means of monitoring effluent DOM in receiving waters. Additionally, the technique has been suggested for use in continuous monitoring of in-plant DOM levels, whereby a waste water treatment and disposal system might use the UV absorbance method to measure both the effluent stream and the receiving waters.

*Ultraviolet radiation, *Monitoring, Waste water, Analytical techniques, Water quality

Ultraviolet absorbance, Dissolved organic matter, Receiving waters

F036
STOCHASTIC VARIATION OF WATER QUALITY OF THE PASSAIC RIVER,

Mehta, B. M., Ahlert, R. C., and Yu, S. L.

Rutgers University, New Brunswick, New Jersey, Department of Chemical and Biochemical Engineering

Water Resources Research, Vol. 11, No. 2, p 300-308, April, 1975. 2 fig, 12 tab, 10 ref.

For managerial purposes it is useful to have reliable estimates of the impact on water quality of changes in wastes effluent quantity or quality, discharge regulation, thermal loading, and precipitation levels among other parameters. Time domain analyses were applied to daily discharge, temperature, oxygen deficit, and BOD data to investigate the stochastic structure of the water quality parameters. Autoregressive integrated moving average (Arima) models were used to describe the random components of these time series. Arima models were found to be useful tools for the simulation or prediction of fluctuations in water quality parameters. Daily discharge residuals can be best described by a second-order one day differencing autoregressive model; daily water temperature by a first-order autoregressive model superimposed on a first-order moving average model; and, daily oxygen deficit by a first-order autoregressive model. The significant correlations obtained between daily BOD loading and daily rainfall are an indication of the acute effect of storm runoff on stream water quality. The Arima models did not provide a satisfactory model for BOD concentration. Even a third-order, one day differencing autoregressive model produced a variance reduction of only 55%.

*Model studies, *Water quality, *Water quality control, Water properties, Water pollution effects, Water quality standards, Statistical models

Autoregressive integrated moving average (Arima)

F037
MODELING SEWAGE TREATMENT PLANT INPUT BOD DATA,

Berthouex, P. M., Hunter, W. G., Pallesen, L. C., and Shih, C.-Y.

Wisconsin University,
Madison, Wisconsin,
Department of Civil and Environmental Engineering

Journal of the Environmental Engineering Division, ASCE, Vol. 101, No. EE1, p 127-138, February, 1975. 5 fig, 2 tab, 6 ref.

Two field studies were conducted to collect data on municipal treatment systems, specifically how they transform dynamic stochastic inputs into treated effluent. The purpose of this study was to describe and characterize the system inputs and outputs with appropriate stochastic models so that effluent quality may be held within some desirable target limits. The problem of modeling a record of hourly BOD influent data was considered. The shortcomings of deterministic models were reviewed. In this application, a stochastic model discovered on the basis of time series analysis was proposed. Such a model contains relatively few parameters, and is simple to interpret and apply. It was concluded that the first-order autoregressive model could be shown to describe the influent BOD data well. However, it was recommended that other sets of data, particularly from other treatment plants, should be examined. Once an adequate model is developed, it may be used in setting emissions standards and for determining various types of control schemes.

*Model studies, *Municipal wastes, *Waste water treatment, Biochemical oxygen demands, Stochastic processes, Facilities

Autoregressive models

F038
BIODEGRADATION OF LINEAR ALKYLATE SULFONATES IN RIVER MODEL,

Fujiwara, K., Sugyama, T., Koike, K., and Oba, K.

Chiba University, Chiba,
Research Institute for Chemobiodynamics

Nippon Eisei gaku Zasshi, Vol. 29, No. 6, p 552-557, February, 1975. 6 fig, 4 tab, 14 ref.

A river model for measuring the biodegradability of organic materials has been developed which simulates the natural aquatic environments. By using this model, the biodegradability of linear alkylate sulfonates (LAS) was determined by using methylene blue and UV spectrophotometry to detect the presence of LAS. LAS which was added to produce a concentration of 10 ppm was shown to be removed almost completely in twenty days from the water fractions and bottom sludge layers by determination with methylene blue. The UV spectrophotometry revealed a residue of about 40% in water fractions and about 25% in the bottom sludge layers even after the 20 day period. The discrepancy of these biodegradabilities might be due to the difference between the principles of the determination methods. The rate of biodegradation of LAS compounds containing alkyl chains in the range from C10 to C14 was fastest in compounds containing the C14 chains and slowest in the compounds contianing C10 chains. LAS compounds having phenyl radicals near the terminal part of thee alkyl chains could be decomposed easily. However, when the phenyl radicals were bound to the inner part of the chains it was more difficult to attack them.

*Biodegradation, *Model studies, *Organic compounds, *Linear alkylate sulfonates, Rivers, Surfactants, Detergents

Methylene blue, Ultraviolet spectrophometry

6446

F039
PRECIPITATION OF PHOSPHATES IN SEWAGE WITH LANTHANUM: AN EXPERIMENTAL AND MODELLING STUDY,

Melnyk, P. B.

Dissertation Abstracts International B, Vol. 35, No. 10, p 4885, April, 1975.

The United States and Canada have designated under the "Great Lakes Water Quality Agreement" that the discharge of phosphates in sewage to the Great Lakes will be controlled. Chemical treatment by precipitation is the most often used treatment method. Chemical dosage selection is empirical and requires extensive experimental studies to be carried out by individual waste water treatment facilities. The use of lanthanum as a chemical precipitating agent is modelled for the desirable dosage. Lanthanum has been found to be an efficient precipitating agent, causing low residual phosphate concentration, and it can be economically recovered and recycled. The solubility products of lanthanum, ortho-, pyro-, and tripolyphosphate, lanthanum hydroxide and carbonate, and the stability constants of the hydroxide and polyphosphate ion complexes were measured. A computer program was utilized for predicting the lanthanum dosage required for a particular residual of dissolved phosphates given the water quality of the waste water as expressed in total aqueous concentrations of ortho- and polyphosphates, calcium, magnesium, carbonates, sodium, chloride, sulphates, and pH.

*Water quality control, *Waste disposal, *Canada, *Waste water treatment, *Phosphates, Sewage treatment, Precipitation (chemical), Recycling

*Chemical treatment, *Lanthanum, Great Lakes Water Quality Agreement

F040
COMPUTER CONTROL OF SEWAGE WORKS PROGRESS AT NORWICH,

Jones, C. E., and Cotton, P.

Public Health Engineer, No. 14, p 46-51, March, 1975. 1 fig, 7 ref.

The progress of a sewage treatment system using a Kent K.70 Central Processer Unit, including a Digital Equipment PDP8E mini computer is discussed. The computer, working at Norwich, Great Britain, has executive control over 60 operating sequences known as control loops as well as 30 subsequences to these loops. Operator control panels and a control setting panel provide communication with the computer. The programs were simulated and site tested, and personnel were given special training in computer technology. The operation in its initial stages has been evaluated and it was found that programming difficulties and faults are minor. An authoritative glossary of sewage treatment terms should be produced to aid communication between various aspects of the control projects. The computer has gone on line; neither the C.P.U. nor the the program have had major problems, and only five days were required to implement 30 percent of the programs. The computer can monitor the duration of storm overflows, operation of stand-by screen, operation of disintegrator pumps, starting and stopping low pressure effluent pump supplying screen, wash-water pump sumps, chemical storage tanks, and the operation of the standby detritor. Additionally, it can attend the main pumping for operating pumps, setting valves, selecting pump duty, and can keep accurate records. The system can automatically adjust certain items such as opening of control valves and speed of pumps more efficiently than by the manual system. Concern was expressed about number of hours of computer down time per 1000 hours; improvements have made the system more reliable.

*Computers, *Waste water treatment, *Sewage treatment, *Automation, *Pumps, Facilities, Personnel, Monitoring

*Central Processer Unit

64

F041
PHYSICOCHEMICAL APPROACH TO WATER AND WASTEWATER FILTRATION,

Ghosh, M. M., Jordan, T. A., and Porter, R. L.

Maine University, Orono, Maine,
Department of Civil Engineering

Journal of the Environmental Engineering Division, ASCE, Vol. 101, No. EE1, p 71-86, February, 1975. 6 fig, 4 tab, 19 ref, 2 append.

The prerequisite to the optimization of granular filter design is a reliable mathematical description of the capture of suspended particles by packed collector grains within a flow. A conceptual model is presented which has been developed for the depth filtration of water and waste water using packed beds. The removal of small particles through uniform sand beds under low speed flows based on the concentration boundary layer theory of diffusional deposition of particles is described. The model is an extension of that proposed by Spielman and Fitzpatrick and includes the effects of gravity, interception, hydrodynamic forces, London attraction, and Brownian diffusion for systems with negligible double layer repulsion. The ultimate capture of a particle in a packed bed is determined by the transport mechanisms and also by the short-range surface forces which are shown to have a dominant role in the particle's attachment to media grains. Experimental results obtained for the filtration of secondary effluent using a polymer-coated sand bed agreed with the predictive model for systems where the effluent was preconditioned using polymeric aids to reduce the double layer forces to a minimum. Jar tests or electrophoretic mobility measurements can be used to determine the optimum dosage of a destabilizing chemical. It was concluded that with proper control, sand filters may be used for the effective removal of very small particles of 0.1 micrometer or less such as viruses and other biocolloids and colloidal inorganic solids.

*Waste water treatment, *Filtration, *Mathematical models, Model studies, Filters, Design criteria

Physico-chemical treatment, Granular filters, Sand filters

F042
HIERARCHIAL MODEL FOR WATER-SUPPLY-SYSTEM CONTROL,

Fallside, F., and Perry, P. F.

Cambridge University,
Cambridge, England,
Engineering Department

Proceedings of the Institution of Electrical Engineers, Vol. 122, No. 4, p 441-443, April, 1975. 4 fig, 1 tab, 11 ref.

A collaborative university-industry research project is being conducted for the introduction of an online computer control system for a water supply network in the United Kingdom. Aspects of the problem of water distribution include modelling and simulation, consumption forecasting, waste detection, and optimal control. Each can be considered as a set of interacting subproblems, within which control effort is subdivided into a hierarchy of control function of ascending complexity. The scheme provides a framework for overall control of the network including optimal pumping control, short term demand forecasting and anomalous-load detection, each to be performed online on a central computer and implemented at the plant by a telemetry scheme. Details of each layer of control is described and proposed implementation via linked computers is discussed. The multilayer concept of control includes control activities associated with a regulator layer, an optimizing layer, an adaptive layer to compensate for disturbances or model induced errors, and a self-organizing control function, which gives feedback on the control-system design. Suitable analytical methods for each layer and practical results of implementation are discussed further in other works by these authors.

*Analytical techniques, *Water supply, *Model studies, *Computers, Control systems, Telemetry, Forecasting, Simulation

Hierarchical computer models

F043
THE SPACE/TIME COEFFICIENT METHOD FOR CALCULATION OF RAINWATER RUNOFF (DAS RAUMZEITBEIWERTVERFAHREN FUER DIE BERECHNUNG VON REGENWASSERABFLUESSEN),

Schulz, H.

Wasserwirtschaft-Wassertechnik, Vol. 25, No. 3, p 99-101, March, 1975.
2 fig, 1 tab, 4 ref.

The space-time coefficient method is a simple model for the approximate calculation of runoff retardations in sewer systems. The space-time coefficient method is based upon Fantoli's mathematical-hydraulical formulas, and represents a generalized simplification of the partial and total retention and translation relations of individual runoff curves. The highest obstruction-free runoff in the sewer system is generated by rainfalls whose duration equals the filling time of the sewer system. More prolonged rainfalls cause either obstruction or runoff under pressure after the filling time. The space-time coefficient curves are based on a computed rainfall for a frequency of n = 1 at a rainfall duration of 45 minutes.

*Sewers, *Runoff, Model studies, Mathematical studies, Hydraulics, Rainfall intensity

Space/time coefficient

F044
THE USE OF COMPUTERS FOR FORECASTING THE SANITARY SYSTEMS OF WATER BODIES (Primeneniye EVM dlya prognozirovaniya sanitarnogo sostoyaniya vodoyemov),

Vaysman, Ya. I., Zaytseva, N. V., Krasovskiy, B. M., and Mikhaylov, A. V.

Gigiyena i Sanitariya, No. 9, p 102-104, 1974.

A computerized method for forecasting the sanitary status of surface water bodies is presented. Factors characterizing the dynamics of waste water discharges and their quantitative and qualitative parameters during the investigation period, the technological water treatment measures to be taken for pollution abatement, as well as the dynamics of the hydrological parameters of the water body were chosen as input data. The algorithm elaborated permits the determination of the concentration of one or more pollutant components as a function of time and of the size of the water body. It also determines the probability of the occurrence of definite pollutant concentrations. The algorithm was tested for the chloride load of the Kama river in the USSR.

*Computers, *Surface waters, Forecasting, Hydrologic aspects, Water treatment, Waste water, Pollutant identification

Waste discharge, U.S.S.R.

F045
LAND-BASED MODELING SYSTEM FOR WATER QUALITY MANAGEMENT STUDIES,

Grayman, W. M., Gates, W. E., and Hadder, A. W.

W. E. Gates and Associates, Incorporated,
Cincinnati, Ohio

Journal of the Hydraulics Division, ASCE, Vol. 101, No. HY5, p 567-580, May, 1975. 6 fig, 4 ref.

A modeling system for water quality management has been designed based on land use/development, waste generation transport-treatment, and the aquatic environment. A computer based tool, the ADAPT (Areal Design and Planning Tool) is composed of: a computer file for storing large amounts of spatially distributed information in a concise but usable format; a series of mathematical submodels to perform design and analysis tasks utilizing the information in the file system; and, a set of display routing to produce computer-generated maps based on the stored information or on the data determined by the submodels. Because ADAPT can store and actively use a large quantity of data associated with comprehensive planning it is a useful tool for dealing with a wide range of environmental problems.

*Computers, *Models, Water quality control, Water management (applied), Data, Model studies, Mathematical models

Areal Design and Planning Tool (ADAPT)

F046
MADAM I--A NUMERIC METHOD FOR DESIGN OF ADSORPTION SYSTEMS,

Weber, W. J., Jr., and Crittenden, J. C.

Journal of the Water Pollution Control Federation, Vol. 47, No. 5, p 924-940, May, 1975. 11 fig, 20 ref.

Physico-chemical treatment systems rely on the control of an activated carbon adsorption system. A general modelling scheme has been developed to describe the dynamics of adsorber processes to facilitate adsorber design. The model is called the Michigan Adsorption Design and Applications Model I (MADAM I) and is based on numeric solution techniques. Because of its numeric base, MADAM I can incorporate dynamic aspects of fluid dispersion, solids mixing, multisolute interactions, and biological growth on activated carbon surfaces. Operational flexibility and accuracy of the model was demonstrated. It is planned that MADAM I will provide optimum design in describing adsorption treatment process characteristics and will reduce costs and planning time for full-scale as well as pilot level studies.

*Activated carbon, *Adsorption, Mathematical models, Planning, Design, Waste treatment, Costs

*Michigan Adsorption Design and Applications Model I (MADAM I), *Physico-chemical treatment, Numeric solutions

F047
A MATHEMATICAL MODEL FOR OPTIMAL WASTE LOAD ALLOCATIONS,

Masqati, M. S.

Oklahoma University,
Norman, Oklahoma

Dissertation Abstracts International B., Vol. 35, No. 11, p 5421, 1975.

The first and most important step in regional water quality management is river basin planning. One of the most effective methods of water pollution control is treatment of wastes before discharge. Although planners have other alternatives, this method is easily implemented and convenient to administer. In order to maintain a required level of quality in stream waters, waste load allocations are made to individual waste dischargers on the basis of the assimilative capacities of the streams in the river basin. Stream waters have been analyzed in the past by large complex simulation models requiring a large amount of input data. What planners need is a model that is regional in nature, can work with inadequate data, and requires a minimum of man and computer time. Such a model has been developed and is used to analyze the quality of stream water in the Verdigris River basin. A linear programming model has been developed to make the optimal waste load allocation, thereby minimizing the total cost of waste treatment to a region.

*Water quality, *Water pollution control, *Mathematical models, River basins, Streams, Waste treatment, Regional development, Planning, Administration

Waste load allocations

F048
DYNAMIC MODELING AND CONTROL STRATEGIES FOR THE ACTIVATED SLUDGE PROCESS,

Busby, J. B., and Andrews, J. F.

Clemson University,
Clemson, South Carolina,
Department of Environmental Systems Engineering

Journal of the Water Pollution Control Federation, Vol. 47, No. 5, p 1055-1080, May, 1975. 22 fig, 3 tab, 45 ref.

A dynamic model is presented which has been developed to model the activated sludge process. This model permits a semi-quantitative description of the dynamic performance of a wide range of activated sludge processes. It is based on material balances of the stored, active, and inert fractions of the MLVSS as well as a sorption expression for the rapid removal of substrate. The model for the aeration basin is coupled with a dynamic model of the solids-liquid separator, which allows a study of the interactions between these two units. A dynamic model of the primary sedimentation basin is included because of its significant influence on the characteristics of the waste water entering the aeration basin. The active mass concentrations predicted by the model for different process configurations were close to those found in the literature. The predicted effects of increasing reaeration and contact times for the contact stabilization process is similar to that of experimental studies. Various control strategies were investigated with the use of the developed model. The application of ratio control to the sludge recycle flow rate as a function of the influent flow rate was found to be beneficial; the best ratio was found to be a function of the sludge settling characteristics and the detention time in the aeration basin. The volume of waste activated sludge may be reduced by regulating the sludge wasting rate as a function of time; the sludge recycle rate must be reduced prior to wasting. Simulation results demonstrated that processes which can operate in a step-feed configuration have advantages over processes where the contacting pattern is fixed.

*Waste water treatment, *Simulation analysis, *Model studies, *Activated sludge,

F049
THE GRAPHICAL HYDROGRAPHS METHOD WITH THE INTERMEDIARY OF STORM OVERFLOWS AND FLOOD RETENTION TANKS (DAS GRAFISCHE ABFLUSSGANGLINIENVERFAHREN MIT ZWISCHENSCHALTUNG VON RUE UND RB),

Lautrich, R.

Wasser und Boden, Vol. 27, No. 5, p 112-115, May, 1975. 8 fig, 1 tab, 7 ref.

An example of the application of the graphical runoff hydrograph method to systems such as storm overflow and flood retention basins is presented. The flood curve gives a true picture of the effects and overlaps of the runoff peaks at different rain intensities. The flow curve, and consequently the runoff curve should be drawn with the computation point as a starting point opposite to the flow direction. The compensating effect of several storm overflow basins can be correctly determined by a runoff curve only.

*Hydrographs, Rainfall intensity, Flow, Runoff, Rainfall-runoff relationships

*Storm overflow, Flood retention tanks, Storm overflow basins

F050
CONTINUOUS MONITORING, AUTOMATED ANALYSIS AND SAMPLING PROCEDURES,

Brezonik, P. L.

Florida University,
Gainesville, Florida.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1241-1249, June, 1975. 92 ref.

Recent literature on continuous monitoring, automated analysis, and sampling procedures for water quality was reviewed. Inorganic substances may be measured by electrometric methods such as ion-selective electrodes for continuous monitoring of water and wastes. Autoanalyzers and modifications of these were discussed in terms of spectrometry procedures. Additionally, oxygen demand, organic matter, and bioassays were described. River and effluent sampling programs need to define objectives in order to optimize cost-effectiveness. Preservation of samples may be achieved chemically; several storage solution formulae are given. Samplers for rainfall collection and for oil extraction are also being developed. Also, concentration-extraction methods are being used to measure organic pollutants in natural waters as well as to analyze mercury levels in seawater.

*Automation, *Sampling, *Monitoring, *Water quality, Inorganic compounds, Effluents, Water, Sea water

Organic pollutants, Autoanalyzers, Rainfall collection, Oil extraction

F051
DIMENSIONING AND DESIGN OF SMALL WASTE WATER PUMPING STATIONS (BEMESSUNG UND GESTALTUNG VON KLEIN-ABWASSERPUMPWERKEN),

Siefert, F.

Technische Mitteilungen, Vol. 68, No. 5, p 167-172, May, 1975. 6 fig.

General problems of the dimensioning and design of small waste water pumping stations are described. It is usually impossible to dimension small-capacity pumping stations for waste water yield. Dry type pumps offer advantages over wet type pumps in that they facilitate cleaning due to a separated suction space. Wet type pumps require lower construction costs and less strict flood protection. Vertical pumps offer increased flood protection, while horizontal layout permits adjustment of the pump capacity to particular flow conditions. Suction and delivery pipes should have a minimum diameter of 100 mm. Delivery pipes should be made of corrosion-resistant steel with a minimum wall thickness of 6 mm. The suction space should be tiled or lined with fiber-glass-reinforced polyester to facilitate scavenging.

*Pumping plants, *Design, *Pumps, Construction costs, Flood protection, Pipes

Small-capacity pumping stations

F052
THE CONTINUOUS MONITORING OF WATER QUALITY,

Best, G. A.

Clyde River Purification Board,
Great Britain.

The Public Health Engineer, No. 15, p 73-84, May, 1975. 9 fig, 6 tab, 11 ref.

The Clyde River Purification Board recently installed two continuous water quality monitors to assess changes and to provide warning when water supply is unsuitable for potable use. The two stations were built at Glasgow Green on the lowest reach of the River Clyde and at Orbiston Park, just upstream of a proposed lake. Installation costs were high, and the stations require regular maintenance by a technician with some knowledge of electronics. Three additional stations have not been built because the Board feels that the available monitoring equipment is not reliable enough. Accurate long-term measurements can be made of dissolved oxygen, suspended solids, pH, conductivity, and temperature. However, better sensors are needed for measuring biodegradable organic matter, phenols, oil, cyanide, metals, and pesticides. Such monitoring stations are useful when they are connected directly to the headquarters' laboratory, so that immediate warnings may be given in cases of water quality deterioration.

*Water quality, *Monitoring, *Warning systems, Water supply, Bodies of water, Dissolved oxygen, Suspended solids, Phenols, Oil, Metals, Pesticides, Installation costs

Clyde River Purification Board, Biodegradable organic matter, Cyanide

F053
COMPUTING THE BIG PICTURE,

Grigg, N. S., and Labadie, J. W.

Colorado State University,
Fort Collins, Colorado,
Department of Civil Engineering.

Water and Wastes Engineering, Vol. 12, No. 5, p 37-39, 85, May, 1975. 3 fig.

The concept of a management information and control system (MICS) as applied to urban water facilities has been named a Metropolitan Water Intelligence System (MWIS). Urban water systems have three major functions: water supply, waste water management, and urban drainage and flood control. Automation of such systems, where feasible, may increase efficiency as well as solve water quality standard and economic and administrative problems. Levels of automation in the United States may be monitoring only, remote supervisory control, computer assisted operator control, or closed loop automatic control. Cities with various stages of automation are Santa Clara, California; Denver, Colorado; Atlanta, Georgia; Monroe County, New York; Seattle, Washington; and San Francisco, California. The effectiveness of any large-scale control approach depends upon: development of adequate models for predicting storm events in real time over an urban center; accurate rainfall-runoff and sewer transport models; reliable communication systems and data processing; and effective feedback control whereby control may be updated as a storm changes, based on successive storm prediction. Although very sophisticated hardware exists in electronics, computers, pneumatics, hydraulics, and measurement, control applications need to be improved to the level of their potential.

*Automatic control, *Water supply, *Urban drainage, *Flood control, Cities, Sewers, Storms, Rainfall, Runoff, Water resources development

Urban water systems, Waste water management

F054
SOLID PARTICLE SETTLEMENT IN OPEN-CHANNEL FLOW,

Li, R-M., and Shen, H. W.

Colorado State University,
Fort Collins, Colorado.

Journal of the Hydraulics Division, ASCE, Vol. 101, No. HY7, p 917-931, July, 1975. 7 fig, 1 tab, 13 ref.

A random walk model was formulated to describe the settlement of solid particles in open-channel flows, and was tested using both poorly sorted and uniform size sediments. The probability density function of the settling length can be a lognormal distribution. An estimation of the mean settling length can be made by computing the ratio of the unit-width discharge to the full velocity of particles. The coefficient of variation is a power function of the ratio between flow shear velocity and full velocity of particles. Results of the simulation agree with measured data, and a procedure for the design of settling basins is presented.

*Computer models, *Sedimentation, *Open channels, Basins, Stochastic processes, Turbulence, Water pollution

Settling

F055
MATHEMATICAL MODELS AND SIMULATION OF WASTEWATER TREATMENT SYSTEMS,

Koide, M., Nogita, S., Tanauma, M., and Shioya, M.

Hitachi Review, Vol. 24, No. 1, p 49-55, January, 1975. 11 fig, 2 tab, 12 ref.

In hierarchical multilevel control systems for waste water treatment, computer control achieves mode changing and parameter correcting to effect feed-forward, optimum, and adaptive control. However, advances in this field have been impeded by difficulty in defining the characteristics of the activated sludge treatment process. Hitachi, Limited, in conjunction with the Tokyo municipal authorities, is studying and developing mathematical models for influent volumes in waste water treatment systems and water quality, and is observing their accuracy at the Mikawashima Sewage Treatment Plant of the Sewerage Bureau of Tokyo Metropolitan Government. New control systems are being discovered through the use of these models, which include a sewage inflow prediction model, an aeration tank model, a final clarifier model, static simulation, and dynamic simulation.

*Waste water treatment, *Mathematical models, Activated sludge, Water quality, Sewage, Model studies, Computers, Simulation analysis

Japan, Computer control, Mikawashima Sewage Treatment Plant, Sewerage Bureau of Tokyo Metropolitan Government

F056
GROSS PARAMETER SOLUTIONS OF JETS AND PLUMES,

Cederwall, K.

Chalmers Institute of Technology, Goeteborg, Sweden.

Journal of the Hydraulics Division, ASCE, Vol. 101, No. HY5, p 489-509, May, 1975. 4 fig, 2 tab, 14 ref, 2 append.

The feasibility of ocean disposal of waste water depends largely on the capacity of the receiving water to dilute and disperse the waste. The problem of determining the extent of dilution necessary to meet disposal objectives is part of disposal scheme design. The successful design of outfall diffusers, for both sewage disposal and discharge of cooling water from thermal power plants, requires mathematical solution of a wide variety of jet and plume diffusion problems. Gross parameter solutions are presented for jets, plumes, and buoyant jets in stagnant, uniform density, or linearly stratified environments. Virtual points and line sources characterized by an absence of mass flux were used in the solutions. The mathematical sources were located at some point relatively close to and downstream of the real source. The mathematical sources reproduced all the bulk characteristics of the discharge from the outlet. Dimensional reasoning was used to determine the basic features of the turbulent flow situation. The ideal flow situations were solved using the basic equations for conservation of mass and momentum. The rate of change of the integral properties of the generated flow fields is given. In principle, the solutions include only one empirical constant, relating the rate of entrainment to the gross variables of the flow.

*Hydraulics, *Waste water disposal, *Oceans, *Mathematical models, Discharge (water), Flow, Diffusion, Hydraulic structures, Hydraulic engineering, Fluid mechanics

Outfall diffusers, Plumes, Jets

F057
DESIGN OF STORM SEWER NETWORKS,

Yen, B. C., and Sevuk, A. S.

Illinois University,
Urbana,
Department of Civil Engineering.

Journal of the Environmental Engineering Division, ASCE, Vol. 101, No. EE4, p 535-553, August, 1975. 4 fig, 5 tab, 15 ref.

Design methods for sizing the pipes of storm or combined sewer systems are evaluated and compared. Such methods include: the steady-flow routing method that is usually used for sewer mains in conjunction with the rational method; the Chicago method; the SWMM; the ISS Model; and a simplified transient flow model called the kinematic-wave model. It is assumed that layout of the sewer network is previously determined, and only hydraulic aspects of sewer design are considered. From this study it was concluded that the steady-flow routing method is relatively the simplest, does not require computer, and can be used for small networks or when high accuracy is not necessary. Of two versions of this method, one which uses time shifting of hydrographs is recommended. No improvement in design of sewers was found using the Chicago or the RRL methods, and they were more complicated than the time-shifting version of the steady-flow method. The ISS Model is the most accurate method of sewer design and is recommended when high accuracy is required and for design of large sewer systems. This model can also be used to evaluate the effect of retention storage in a sewer system on storm runoff. However, the ISS model requires the use of digital computers. The SWMM and the kinetic-wave models should be used for a performance quality rated between the ISS and steady-flow routing models; they provide moderate accuracy and may be applied to large sewer networks.

*Design criteria, *Model studies, *Sewerage, Storm runoff, Water resources development, Water management (applied), Combined sewers

*Steady-flow routing model, *Chicago model, *SWMM, *ISS Model, *Kinematic wave model, Flow models

F058
INSTRUMENTATION FOR MONITORING WATER QUALITY,

Briggs, R.

Stevenage Laboratory,
Herts, Great Britain,
Water Research Centre.

Water Treatment and Examination, Vol. 24, Part 1, p 23-45, 1975. 10 fig, 2 tab, 21 ref.

Methods and instrumentation for monitoring water quality currently used in Great Britain are reviewed. Required units and limits of accuracy for data from automatic water quality monitors are given for the parameters of temperature, dissolved oxygen, oxidized nitrogen, ammoniacal nitrogen, organic matter, suspended matter, conductivity, chloride, hardness, pH value, sunlight intensity, and dissolved carbon dioxide. In order to achieve consistency, standards must be set for sampling frequency and sampling position. Types of available land-based package water quality monitors are described and the field performance of selected land-based monitoring stations in the United Kingdom is analyzed. Telemetry networks for water quality monitoring and the connection between automatic and manual control schemes are discussed. Many optical devices have been developed to monitor suspended solids concentration in river waters and effluents, and such sensors are accurate as long as optical surfaces are kept clean and if enough frequent calibrations are carried out to correct for errors arising from variations in particle density and size distributions. Specific instrumentation for measuring organic pollution, monitoring heavy metal concentrations, measuring ammonia, and detecting toxicity of pollutants to aquatic life are presently being developed.

*Instrumentation, *Monitoring, *Water quality, Sampling, Suspended solids, Heavy metals, Toxicity, Ammona, Data collection

F059
RAIN RECORDINGS AS BASIS FOR THE DIMENSIONING OF RAIN RUNOFF SYSTEMS (REGENSCHREIBERAUFZEICHNUNGEN ALS GRUNDLAGE ZUR DIMENSIONIERUNG VON REGENWASSERABLEITUNGSANLAGEN),

Bosold, H.

Wasserwirtschaft-Wassertechnik, Vol. 25, No. 5, p 176-178, 1975. 8 fig, 2 tab, 5 ref.

Rain water yields in liters/second were calculated for the Leipzing and Halle-Kroellwitz areas, East Germany, on the basis of pluviometric recordings and were compared to the conventional Reinhold calculations. The recordings were used in such a manner that each individual rainfall was arranged with its average rain yield as a function of the number of the rainfall hours per year and the number of the rainfall events according to their intensity, regardless of intensity fluctuations. The rain yield duration and rain yield frequency curves obtained for the two monitoring stations showed very few differences, which implies their applicability to the entire Halle-Leipzig area. However, considerable differences in storm runoff may be found to occur between the local and Central European rain yields.

*Mathematical models, *Rainfall, Measurement, Monitoring, Storm runoff, Rainfall-runoff relationships

Rain water yields, East Germany

F060
MONITORING THE ENVIRONMENT,

Heins, C. F., Johnson, F. D., and Mangold, E. C.

Denver University Research Institute,
Colorado.

Environmental Science and Technology, Vol. 9, No. 8, p 720-725, August, 1975.

Four developments in environmental monitoring are examined. These are spectroscopy, satellite transmission of environmental data, remote sensing, and computerized data processing. Improvements in instrumentation and techniques have occurred in response to stringent environmental legislation. Spectroscopic instruments are used primarily for atmospheric monitoring. Satellites have been tested for the relay of collected data from remote, automatic collection systems. The earth resources satellite LANDSAT and a system of Data Collection Platforms (DCP's) are used to collect and transmit data in digital form from sensors. Another system, designed for hydrological, meteorological, and oceanographic data is made up of the Geostationary Operational Environmental Satellites (GOES), which are being used by both governmental agencies and industrial firms. Several remote sensors are also being developed, based on technologies of correlation spectrometry, infrared sensors, and LIDAR (light detection and ranging) systems. With the continued use of such sensing, data collection, and satellite transmittal devices, specialized computer programs for interpretation of data have become increasingly important. Software programs used to identify bodies of water, to trace the paths of storms, and to classify land usage through digital imagery are being developed to assimilate the quantities of information which may be obtained from these new methods of environmental measurement.

*Monitoring, *Spectroscopy, *Satellites (artificial), *Remote sensing, *Data processing, *Computers, Instrumentation, Environmental control, Automation

LANDSAT, GOES

F061
ANOTHER LOOK AT THE NRC FORMULA,

Schroeder, E. D., and Tchobanoglous, G.

California University,
Davis,
Department of Civil Engineering.

Water and Sewage Works, Vol. 122, No. 7, p 58-60, July, 1975. 2 fig, 8 ref.

The NRC (National Research Council) formula on which a design model for trickling filters has been based was critically examined. While this model is widely accepted, data for the formula were obtained over thirty years ago. The equation of best fit was stated as: E (or percent efficiency)= 100(weight of BOD removed by the filter and clarifier/weight of BOD applied including recycle). This was also expressed as E = 100/(1 + 0.0085 times the square root of (the weight of BOD5 per day/gross volume in acre feet x the number of passes through the filter)). When the NRC formula was developed, its two constraints were that efficiency was forced to be 100% when the loading rate was zero, and that recycling trickling filter effluent was assumed to be beneficial. When alternate methods of fitting curves through the data were considered, there was no fit found for which the quality was particularly good. The formula neglects differences in temperature, waste water constituents, media characteristics, and other factors, and considers only volumetric flow rate, BOD5, and filter volume. Thus, in designing a trickling filter, it was suggested that the engineer not use the NRC formula as a standard, but rather test any new facility by a pilot plant study.

*Trickling filters, *Mathematical models, *Design criteria, Filters, Biochemical oxygen demand, Biological treatment, Engineering, Waste water treatment

NRC formula, Goodness-of-fit

F062
PREDICTION OF THE EFFECTS OF THE FLOODWATER OF THE OLONA RIVER IN TICINO (PREVISIONI SUGLI EFFETTI DELLA IMMISSIONS DELLE ACQUE DI PIENE DELL' OLONA IN TICINO),

Marchetti, R., Provini, A., and Zambon, G.

Inquinamento, Vol. 17, No. 6, p 19-33, June, 1975. 14 fig, 13 tab.

A canal is being built for flood control purposes between the Olona River at the village of Rho and the Ticino at Mt. Abbiategrasso (near Milan, Italy), traversing a distance of 24 kilometers, and will handle overflow loads in the Olona exceeding 10 cu m per second. As a consequence of a potential for pollution of the Ticino from pollution problems in the Olona, a study was made to determine what effect this would have on the Ticino water, utilizing samples of the Olona made between 1970 and 1972 at Rho. Using analyses of 77 water samples taken at various times of the year, which included determinations of mineral and organic particulate, material capable and incapable of sedimentation, oxygen content, BOD, COD, metals, ammonia, pH, anionic detergents, toxicity, eutrophicating compounds, and phosphorus and nitrogen compounds, statistical studies were made. These predict what effects the Olona flood waters would have on the Ticino when the overflow channel is in operation. It was concluded that a negligible amount of self-purification would take place as the Olona water traverses the 24 km length of the canal.

*Flood control, *Canal construction, Rivers, Water analysis, Flood forecasting, Model studies, Statistical analysis, Overflow

Olona River (Italy)

F063
STUDY OF THE RELATIONSHIP BETWEEN EFFICACY OF PURIFICATION AND CONSTRUCTION AND OPERATING COSTS OF PURIFICATION PLANTS (UNTERSUCHUNG UEBER DIE BEZIEHUNG ZWISCHEN REINIGUNGSGRAD UND BAU UND BETRIEBSKOSTEN VON KLARANLAGEN),

Heberling, G., and Hahn, H.

Gas-und Wasserfach-Wasser/Abwasser, Vol. 116, No. 5, p 206-208, May, 1975. 5 fig, 14 ref.

Correlations between waste water purification efficiency and the construction and operating costs of waste water treatment plants were investigated. Regression analysis was performed on the basis of data from 179 waste water treatment plants put into operation between 1955 and 1972 in West Germany and elsewhere. The regression analysis showed no significant correlation between predetermined purification efficiency goal and the construction and operating costs for new waste water treatment plants. However, a close correlation was found between the expenditures and the population equivalents to be connected to the waste water treatment plant. This correlation, in conjunction with the finding that 84% of the waste water treatment plants reached BOD5 elimination efficiencies over 80%, permits the establishment of universally applicable mathematical models.

*Waste water treatment, *Operating costs, *Construction costs, *Treatment facilities, Mathematical models, Biochemical oxygen demand, Regression analysis

*Germany

F064
THE FORECASTING OF INFLOW VARIATION INTO THE WASTE WATER TREATMENT FACILITY IN THE NEW TOWN,

Hiraoka, M., Murakami, T., Yamamoto, O., Horii, Y.

Yosui to Haisui, Vol. 17, No. 7, p 849-853, 1975. 8 fig, 5 tab, 4 ref.

Variation of inflow of waste water to a treatment plant at Izumi Kita, Japan, was forecasted by a regional system. The relationship between water supply and waste water was investigated in order to control the waste water variation by water supply variation. Water supply and waste water showed a similar daily flow pattern; waste water had its daily peaks at 9-10 am and after 10 pm. Variation of water supply was extremely broad with a maximum supply of 2,000-2,500 cu m/h and a minimum of 200 cu m/h. Except for one case, water supply flow was considerably higher than waste water. This was due to the conservation in the activity system and transfer to outside of the regional system. Results of investigating the correlation coefficient between water supply variation and waste water variation suggested effective forecasting of inflow waste water variation by water supply variation corresponding to a lag time of about one hour.

*Waste water treatment, *Treatment facilities, Water supply, Inflow, Mathematical models, Flow, Forecasting

Japan, Inflow variation, Regional forecasting

F065
EVOLUTION OF OPERATION CONTROL IN WATER TREATMENT (A VIZ-
TISZTITASI TECHNOLOGIAK UZEMIRANYITASANAK FEJLODESE),

Kerese, J.

Hidrologiai Kozlony, Vol. 55, No. 6, p 266-272, June, 1975. 3 fig.

Automatic control systems for water treatment in Hungary, under the auspices of the Melyepterv Corporation, are outlined. Equipment is used to process the signals given and to measure data for the control of the flushing of closed drum filters, the backwashing and filter operation of open and closed sand filters, and the rate of chemical feed combined with automatic tank switchover and actuated by flow rates. Pumping stations have been equipped with constant and variable speed pumps to deliver raw and treated water. Methods adapted for data collection, display, and recording at a central control station are detailed, along with the capabilities of the decision unit and its relationship to the control technology.

*Water treatment, *Computers, *Control systems, *Automation, Filters, Data collection

Hungary, Melyepterv

F066
MATHEMATICAL MODEL OF WATER CHARACTERISTICS IN THE SEWAGE TREATMENT PLANT (Gesui shorijo ni okeru suishitsu tokusei no sushiki model),

Kuzuoka, T., and Hitomi, O.

Kemikaru Enjiniyaringu, Vol. 20, No. 6, p 32-38, June, 1975. 7 fig, 2 tab, 19 ref.

Mathematical models for sewage treatment by an activated sludge method are illustrated. The method generally consists of initial sedimentation, aeration, and final sedimentation. Water quality from the initial sedimentation can be obtained by a simple Voshel equation. For an aeration basin, water quality is obtained by resolving material balance equations involving flow rates and reactivity of water, microorganisms, substrate, and the variations in microorganism activity. Corrections of equations by using a parameter for the decreasing rate of microorganisms cultivated in synethtic sewage water were found suitable for most available equations for the aeration process. Water quality can be kept at a stable level by allowing microorganisms to remain in the aeration tank for a constant period of time. Two equations used to calculate suspended solids values for the final sedimentation tanks at two water treatment plants from 1966 to 1969 gave satisfactory results.

*Mathematical models, *Sewage treatment, *Activated sludge, Aeration, Microorganisms, Water quality control, Suspended solids, Treatment facilities, Flow rates

Material balance equations, Voshel equation

F067
A SIMULATION MODEL FOR STUDYING EFFECTS OF POLLUTION AND FRESHWATER INFLOW ON SECONDARY PRODUCTIVITY IN A ECOSYSTEM,

Johnson, R. W.

North Carolina State University,
Raleigh.

Dissertation Abstracts International B., Vol. 36, No. 2, p 533, 1975.

A simulation model was developed to evaluate the ecosystem of Galveston Bay, Texas. The effects of humans on secondary productivity (harvestable species such as fish and shellfish) is defined in terms of factors such as quantity and quality of inlet fresh water and pollutants. Information was derived from existing physical parameters model and from pertinent biological measurements. The purpose of this model is to provide predictive information for the management of estuaries. The results were particularly useful to pollution control and fisheries management in systems having migrating species of fish, shrimp, and crabs. The Galveston Bay, Texas, area was found to be a highly productive temperate-zone ecosystem, subject to human related stresses. An objective of this study was to identify which biological, chemical, and physical parameters should be measured for the development of models of similar ecosystems.

*Model studies, *Water pollution effects, Environmental effects, Water management (applied), Water resources development, Estuarine fisheries, Estuarine environment, Texas, Data collection, Simulation analysis, Model studies, Water pollution control, Shrimp, Fish migration, Fish management

F068
GROWTH KINETICS OF HETEROGENEOUS MICROBIAL POPULATIONS AND THE MODELLING OF BIOLOGICAL WASTE TREATMENT REACTORS,

Michellepis, C. P.

Dissertation Abstracts International B., Vol. 36, No. 3, p 1390, 1975.

A study was performed to ascertain whether, at constant temperature, the growth parameters of heterogeneous populations in the activated sludge process are determined solely by the composition of the waste or whether they are also a function of solids retention time (SRT). Mathematical models assume that these parameters are true constants. Bench-scale activated sludge units were operated, of the continuous-flow, completely-mixed type. Various rates of dilution, recirculation and cell wastage were compared, with and without cell recycle. During these growth studies, the increase in biomass, carbon uptake, and oxygen uptake were monitored. Results showed rapid "initial" uptakes of organic carbon and increases in optical density which had no apparent effect on oxygen uptake. The apparent biomass yield was found to be a function of solids retention time, but the "true" biomass yield coefficient was independent of SRT. Data were well correlated by a relationship between specific growth rate and the food:microorganism ratio proposed by Fujimoto. The maximum specific growth rate was strongly correlated with the net specific growth rate of the continuous flow cultures. It was concluded that the growth parameters of heterogeneous populations which operate under one set of conditions should not be used for the prediction of process performance under different operating conditions. A mathematical model for a completely-mixed biological reactor was developed, based on the growth equation of Fujimoto. In batch studies, there was a reasonable agreement between the expected and observed biomass concentrations and observed substrate concentrations were lower than predicted ones.

*Activated sludge, *Mathematical models, Temperature, Microorganisms, Growth rates, Kinetics, Biomass, Biological treatment, Waste water treatment, Monitoring

Fujimoto equation, Food to microorganism ratio, Solids retention time, Bench-scale studies

F069
EFFECT OF VALLEY SHAPE ON RETENTION BASIN PERFORMANCE,

Pagan, A. R.

Public Works, Vol. 106, No. 8, p 84-85, August, 1975. 4 fig, 1 tab.

A mathematical model was designed to emphasize the importance of the cross-section profile of the valley behind a flood control structure for engineers responsible for selecting storage reservoir sites. Because the amount of storage available should increase as rapidly as possible with increasing depth in order to get the greatest amount of outflow reduction, a U-shaped valley was suggested to be much more effective in suppressing flood peaks than a V-shaped valley. In order to quantify this, an imaginary stream was assumed as well as an outflow versus depth hydrograph. The following curves were used: inflow hydrograph (same for both V-shaped and U-shaped valleys); storage versus depth curve for V-shaped valley; storage versus depth curve for U-shaped valley; and outflow versus depth curve. From these were constructed storage versus outflow curves for V-shaped and U-shaped valleys and 2S/t + O versus outflow curves for V-shaped and U-shaped valleys. When all these curves were plotted, the standard routing procedure was followed and the resulting outflow hydrographs for each valley shape were compared. It was determined that the peak outflow for the V-shaped valley was 330 cfs and for the U-shaped valley 245 cfs. The percentage of peak inflow was 36.7 for the V-shaped valley and 27.2 for the U-shaped one. Peak storage capacities were 2.25 million cu ft and 2.95 million cu ft, respectively. A greater amount of land might be needed with less advantage for the less efficient V-shaped storage reservoir. Additionally, the routed peak outflow of the U-shaped valley was 74 percent of that of the V-shaped valley.

*Flood control, *Retention, Outflow, Mathematical models, Reservoirs, Storage capacity, Hydrographs, Engineering

F070
TREATMENT PLANT MONITORING PROGRAMS: A PRELIMINARY ANALYSIS,

Berthouex, P. M., and Hunter, W. G.

Wisconsin University,
Madison,
Department of Civil and Environmental Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 8, p 2143-2156, August, 1975. 9 fig, 3 tab, 11 ref.

A preliminary analysis is presented on monitoring programs for small treatment plants. While daily sampling is legally required of all plants, in practice many small plants do no reporting of effluent quality. A compromise between daily monitoring and no monitoring at all is to sample at reasonable intervals. The frequency of sampling required is derived from basic control chart theory, balancing the protection purchased against the cost. An outline of a very simple sample-average control chart illustrates that the decisions to be made have probability-related consequences. Thus, it may be decided from data collected that the plant is in control or out of control. The consequence of deciding that it is out of control when it is in control is the added cost of trying to locate a non-existent upset, while the consequences of deciding that the plant is in control when in fact it is out of control is the cost of remedying the upset, the cost of having water that is not clean, and the cost of paying a pollution penalty fine. Results calculated showed that a sampling interval of 3 to 4 days should provide protection without overburdening a small facility financially. While for large plants, industries, or small plants in environmentally sensitive areas, daily monitoring should be enforced, the cost-benefit relationship for small treatment plants indicates that regulatory agencies should consider more realistic alternatives.

*Monitoring, *Treatment facilities, *Waste water treatment, Regulation, Decision making, Water pollution control, Cost-benefit analysis, Control systems, Sampling, Statistical methods, Mathematical models

F071
MATHEMATICAL MODEL FOR ESTABLISHING THE OVERFLOW SPILLWAY DISCHARGES IN THE FLOOD STORAGE PONDS,

Ionescu, V., Chebeleu, D., and Berar, U.

Economic Computation and Economic Cybernetics Studies and Research, No. 2, p 71-79, 1975. 3 fig, 2 tab.

Equations are presented for the establishment of overflow spillway discharges in storm water retention basins. Overflow spillway discharge is dependent upon the two variables base and height of the spillway wave, which can be modified so that they correspond to an economic minimum. A network of water storage basins is being designed for the most economical system of flood attenuation for the area of the Transylvanian high plains. The amount of overflow spillway discharge was determined by a mathematical model using a calculus program to optimize the economic solution. The scheme has been integrated into a computer program and its details are graphically illustrated.

*Overflow, *Storm runoff, *Floods, *Mathematical models, Computers, Economics, Storage

Transylvania

F072
OPTIMIZATION OF FILTRATION FOR SURFACE WATER TREATMENT (OPTIMIERUNG DER FILTRATION BEI DER OBERFLAECHENWASSERAUF-BEREITUNG),

Kavanaugh, M.

Vom Wasser, Vol. 43, p 53-71, 1974. 8 fig, 12 ref.

A simple model of particulate collection and head-loss buildup in granular media filtration has been developed. Assumptions made in design of this model were substantiated through filtration experiments conducted in small laboratory columns (ID = 10 cm) using glass beads as media and latex microspheres as model colloids. One application of the model was illustrated by a hypothetical design problem for contact filter treating a clay suspension destabilized with a cationic polyelectrolyte. By using pilot plant scale tests, the model should be useful in estimating optimum process conditions for a given filtration problem.

*Model studies, *Filtration, *Laboratory tests, Polyelectrolytes, Filters, Surface waters, Waste water treatment

Particulate collection, Head loss buildup

F073
LONG-TERM FLOOD PREDICTION FROM SHORT-TERM RIVER DATA,

Search, Vol. 6, No. 7, p 250-251, July, 1975.

The problems of flood forecasting in Australia were discussed at the Institute of Engineers' Hydrology Symposium at Armidale. In the Queensland area, streamflow records have only been kept for the past ten years. Because of this, accurate predictions of larger, less frequent floods are not feasible by direct methods. However, the Queensland Irrigation and Water Supply Commission has developed an indirect method to give useful long-term flood forecasts. It was found that annual flood maxima in a catchment have a very close statistical relationship with daily runoff volume in the same catchment. Rainfall records have been kept for a much longer time than streamflow records. Daily runoff volume correlates with rainfall. The rainfall/runoff relationship belongs to a common family of curves, which can be considered in terms of the parameter K2. The K2 value was demonstrated to be useful in obtaining long-term flood predictions from long-term rainfall records. The method was checked for eight catchments for which about of 30 years of complete records were available. The maximum one-in-fifty years and one-in-one hundred years floods were predicted, and the predictions were compared with those made conventionally from the full flood record. The difference between the two predictions (on the average) was less than eight percent. Thus it may be possible to make reasonably accurate predictions for other catchments with only rainfall data.

*Flood forecasting, *Rainfall-runoff relationships, Australia, Rainfall, Mathematical models, Statistical models, Streamflow

F074
BAYESIAN INFERENCE AND DECISION MAKING FOR EXTREME HYDROLOGIC EVENTS,

Wood, E. F., and Rodriguez-Iturbe, I.

International Institute for Applied Systems Analysis,
Laxenburg, Austria,
Schloss Laxenburg.

Water Resources Research, Vol. 11, No. 4, p 533-542, August, 1975. 11 fig, 3 tab, 15 ref.

An analysis of parameter uncertainty and the effects of model uncertainty upon decision making, as applied to flood prediction, is discussed. It is argued that the decision theory approach to making decisions is a more rational approach than other procedures which separate inferences, decisions, and preferences. A case study was presented for the determination of the best level of flood protection for Woonsocket, Rhode Island. Each of three probability models was compared, and the Bayesian procedure was employed. Prior data from a regional regression model, historical data, and realistic flood cost and damage functions were used. A calculation was made of the composite Bayesian distribution of flood discharges, which was then used in conjunction with an appropriate utility function to maximize expected utility and net benefits. The results of the Rhode Island study confirmed the expectation that Bayesian statistical procedures could be used to make engineering decisions.

*Hydrologic aspects, *Mathematical models, *Flood forecasting, Statistical models, Cost analysis, Decision making, Engineering

Bayesian inference, Cost-benefit analysis

F075
DISTRIBUTED PARAMETER SYSTEMS APPROXIMATION FOR ESTUARINE WATER QUALITY MODELLING AND CONTROL,

Olufeagba, B. J.

Dissertation Abstracts International B., Vol. 36, No. 2, p 878, 1975.

Water quality in an estuary was described by a set of coupled distributed parameter systems. Both long term and short term effects for Jamaica Bay, New York, were investigated. Short term water quality was described by a system of coupled mixed initial boundary value dispersion-advection evolution equations. A method was developed using a stepwise convergent technique. Results of a semi-linear multi-constituent model for the biota and nitrogen cycle indicated that the biota did not satisfy the hypothesis of immotility. For long term water quality effects, a mixed Dirichlet-Neumann elliptic boundary value problem in two spacial dimensions was satisfied, and the effects were reduced to a set of coupled multi-point boundary value problems for ordinary differential equations. Long term control problems, involving coliform and dissolved oxygen were studied in order to calculate optimal management policies for the Jamaica Bay area. An algebraic representation was developed for the dissolved oxygen concentration at specific points in the bay as a function of the treatment levels at water pollution control facilities discharging into the bay. Three management policies for achieving the DO standard for 1980 were proposed, as calculated by defining the optimal nitrification at each of four treatment plants in the Bay.

*Water quality, *Water management (applied), *Mathematical models, Dissolved oxygen, Coliforms, Nitrification, Treatment facilities, Water pollution control

Jamaica Bay (NY)

F076
SIMULATION OF BOD AND DO BALANCE WITH RESPECT TO A POLLUTED SHALLOW RIVER (PART I): MATHEMATICAL MODEL,

Aiba, S., Okada, M., Otake, H., Sudo, R., and Mori, T.

Gesuido Kyokaishi, Vol. 12, No. 131, p 33-38, April, 1975. 5 fig, 11 ref.

A physical-mathematical model was derived for urban river systems, emphasizing the effects of algae on biochemical oxygen demand and dissolved oxygen. The model was particularly designed for shallow and narrow rivers such as those in Japan. Quantitative analyses of daily variation of dissolved oxygen by algae and of second stage BOD were performed. Second stage BOD was determined by the adsorption structure of algae, water velocity, water temperature, and the quantity of the adsorbed algae on the river bed. The overall rate of photosynthesis of algae and the respiration rate were determined by illumination and dissolved oxygen, respectively, and by constants which depend on the physiological conditions of the algae. The physical-mathematical models for BOD and DO balances were then derived by using the above parameters and the flow conditions of the river.

*Biochemical oxygen demand, *Rivers, *Pollutant identification, *Model studies, Simulation analysis, Dissolved oxygen, Mathematical models, Algae, Flow characteristics

F077
REPRESENTATION OF MACROSCOPIC FLOW IN AN AERATION BASIN BY A CASCADE FORMED BY TWO UNEQUAL PERFECT MIXERS (REPRESENTATION DE L'ECOULEMENT MACROSCOPIQUE DANS UN BASSIN D'AERATION PAR UNE CASCADE DE DEUX MELANGEURS PARFAITS INEGAUX),

Elmaleh, S., and Ben Aim, R.

Universite des Sciences et Techniques du Languedoc,
Montpellier, France,
Laboratoire de Genie Chimique, Traitement des Eaux.

The Chemical Engineering Journal, Vol. 9, No. 2, p 107-114, April, 1975. 10 fig, 1 tab, 7 ref.

Few investigations have been conducted on the mixing in an aeration tank, and either perfect mixing or plug flow has generally been assumed. In this study, the Retention Time Distribution (RTD) was determined in a 12 cu cm tank aerated by coarse bubble diffusers. Mixing was independent of liquid flow in the test range but increased with air flow. The RTD curves were interpreted by a model of two unequal perfectly stirred reactors. Experimental curves were fitted to the model with peak time. Thus, the model parameter was linked to air flow and agreement between experimental and theoretical curves was determined to be good.

*Aeration, *Model studies, Mathematical models, Mixing, Flow measurement

Aeration tanks, Retention time distribution

F078
LARGE SYSTEMS APPROACH TO WATER QUALITY MODELLING AND MANAGEMENT,

Penumalli, B. R.

Texas University, Austin, Texas.

Dissertation Abstracts International B, Vol. 36, No. 2, p 878, 1975.

A large systems approach to the problem of estuarine water quality modelling and management is discussed. Analytical techniques of solutions of the hydrodynamic and transport equations, which are fundamental to estuarine water quality modeling, become intractible. Numerical techniques are discussed. The problems are mostly highly dimensional and suit themselves well to matrix models with a simple structure. An error correction algorithm is developed and used to solve the matrix model. The accurac of the solution is judged by an analytical calibration criterion and an error analysis method. The approaches developed have been applied to the Corpus Christi Bay on the Gul Coast of Texas. An existing hydrodynamic model for the area has been modified for the study to obtain the necessary hydrodynamics for the water model. Two types of models were used with field data. The objective of this study was minimization of the total cost of treatment and variables of optimization, and a generalization of standard water quality.

*Water quality, Analytical techniques, Numerical analysis, Estuaries, Water resources development, Model studies, Water management (applied), Cost analysis

Corpus Christie Bay (Tex), Matrix model

F079
DENVER SEEKS TOMORROW'S WATER TODAY,

Michel, H., and Oliger, G.

Parsons, Brinckerhoff, Quade and Douglas, New York,
New York.

Water and Wastes Engineering, Vol. 12, No. 8, p 31-35, August, 1975. 2 fig.

The Denver Board of Water Commissioners' plans to develop economically and environmentally sound water sources for the future, using the Eagle, Piney, and Colorado Rivers, are discussed. Four major tasks were required: a hydrologic study; a geological survey; an environmental evaluation; and an operational study. The limits of taking water out of a river forced three considerations: existing water rights; streamflow characteristics; and how the water rights affect the flow at selected points on the stream. Analyzing the exercising of a combination of the existing water rights was a complex task, and, hence, required a computer simulation model. The model selected had been used successfully on other Colorado river projects. The configurations obtained from this method were checked against a geological survey and their environmental impact was considered. The geological survey eliminated some of the configuration choices. After this analysis, four configurations were selected for more detailed analyses. An operational study was then undertaken, along with a cost analysis to choose the best configuration from these four. Another computer simulation model was used for these studies. It was found that the Eagle-Piney/Eagle-Colorado configuration had the greatest firm annual delivery and the lowest unit cost.

*Computer models, *Water rights, *Water resources, Geological surveys, Environmental effects, Streamflow, Cost analysis, Colorado River

*Denver (Colo), Eagle River, Piney River, Hydrologic study, Operational study

F080
CLASSIFICATION OF MODELS TO TIDAL WATERS,

Himwood, J. B., and Wallis, I. G.

Monash University, Clayton, Australia,
Department of Mechanical Engineering.

Journal of the Hydraulics Division, Vol. 101, No. HY10, p 1315-1331, October, 1975.
1 tab, 141 ref.

The development and direction of a water quality program for estuaries and tidal inlets requires a model to predict the mixing and movement of wastes discharged into the water. The models available are discussed in terms of the representations and simplifications used, and the range of conditions under which each model is satisfactory. The models all assume the wastes are miscible neutrally buoyant. The three general approaches to modelling water and waste movement include physical hydraulic models, passive electrical analog, and mathematical models. A numerical solution of the partial differential equations that describe water movement and pollutant transport is usually the most productive model. Only numerical models are considered in this discussion. The classification scheme presented is based on the number of spatial dimensions, the reference frame used, and the degree to which the hydrodynamic processes are included in any model. The factors governing the choice of a model for a particular investigation include: the use to be made of the model as part of the total investigation; the resources available for the study; the nature of the wastes; and, the nature of the estuary and its boundaries. The answers to these questions permit the selection of the appropriate type of model. The classification table will then indicate the models available to meet the requirements of the physical situation.

*Waste water disposal, *Mixing, *Mathematical models, *Estuaries

F081
CORRELATION OF VARIOUS MONITORING ITEMS RECARDING POLLUTION SUBSTANCES OF HUMAN WASTES AND TREATED WATER (Shinyo to sono shorisui no odaku sibun ni kansuru kakushu sokutei komoku kan no sokan ni tsuite),

Nagasawa, T., Tanaka, N., and Yashima, T.

Kyotofu Eisei Kenkyusho Nenpo, p 83-90, March, 1975. 6 fig, 3 tab, 6 ref.

Correlations among various measured items for water released from the second oxidation tank and overflow water from the final sedimentation tank of a total oxidation treatment method and for overflow water from the final sedimentation tank of a digestion activated sludge method were studied. The measured items included BOD, evaporation residue (ER), ignition loss (IL), COD(30-min), COD(4-hr), albuminoid N (Alb-N), ammonial N(Ammon-N), Alb-N+Ammon-N, iodine demand (ID) and chloride ion. Close correlations were found between the COD(4-hr), ER, IL and chloride ion of the released water from the second oxidation tank. Other items also showed noticeable correlations. Smaller amounts of correlation were found between the measured items for the overflow water from the final sedimentation tank of the total oxidation method, and better correlations were found for the overflow water from the final sedimentation tank of the digestion activated sludge method.

*Monitoring, *Water pollution control, *Sewage, *Waste water treatment, Oxidation, Biochemical oxygen demand, Ammonia, Sedimentation, Activated sludge

F082
SIMULATION OF BOD AND DO BALANCE WITH RESPECT TO POLLUTED SHALLOW-RIVER (PART 2): SIMULATION EXAMPLE FOR MIDDLE COURSE TAMAGAWA (Asai odaku kasen ni okeru BOD, DO shushi no simurashon (Dai 2 ho): Tamagawa churyuiki e no tekiyo rei),

Aiba, S., Okada, M., Otake, H., Sudo, R., and Mori, T.

Gesuido Kyokai-shi, Vol. 12, No. 132, p 26-37, May, 1975. 18 refs.

Data obtained at eleven locations between Hanemura dike and Chofu dike, Japan, (total length 93 km) in August 1972 were used for a simulation model of BOD and dissolved oxygen balance in a polluted shallow river. Water temperature was recorded by the Japanese standard method using a glass thermometer; clarity was measured by a one m meter. Illumination was recorded by a 2501-A model illuminometer while pH value was measured by a colorimetric method. Dissolved oxygen, COD, total phosphorus, and BOD were also determined by appropriate standard Japanese methods. Nitrogen was determined by a spectrophotometric method. Dissolved oxygen and COD at Hinobashi ranged from 4.4 mg/liter at 10:30 p.m. to 19.9 mg/liter at 8:30 a.m., and from 2.2 mg/liter at 10:30 p.m. to 4.0 mg/liter at 1:30 p.m., on August 15, respectively. The overall photosynthesis and respiration rates for algae were measured and various parameters were estimated for the simulation. A greater second stage BOD load was obtained, due to inaccurate river bed area calculated by Mannings equation. Results of the simulation also showed lower BOD and restoration of dissolved oxygen at night.

*Rivers, *Biochemical oxygen demand, *Dissolved oxygen, Water quality, Colorimetry, Model studies, Simulation analysis, Chemical oxygen demand, Mannings equation, Spectrophotometry

Japan

F083
CHEMICAL TREATMENT FOR PHOSPHATE CONTROL,

DeBoice, J. N., and Thomas, J. F.

California University,
Berkeley,
Division of Hydraulic and Sanitary Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 9, p 2246-2255, September, 1975. 4 fig, 4 tab, 11 ref.

A computer program has been developed that is useful for determining the general effects of waste water treatment process modifications and variations on calcium phosphate precipitation and for comparing the efficiencies of alternative treatment processes. The program is based on an equilibrium model which considers precipitation of Ca3(PO4)2 and CaCO3 with pIAP values of 25.46 and 7.13, respectively. Pilot plant results were in agreement with computer results. The chemical process found to have the greatest effect on phosphate precipitation was the exchange of carbon dioxide with a gas phase. More than 90% of the phosphate in a typical waste water with an initial pH of 7.1, total calcium of 60 mg/liter as Ca, and total orthophosphate of 9.3 mg/liter as P could be precipitated by equilibrating the solution with an atmosphere containing 0.033% CO2. Additionally, higher final phosphate concentrations are to be found in processes with high levels of dissolved CO2 than those with low levels of dissolved CO2. It was recommended that the techniques and methodologies developed to solve this problem should be used for other areas. Similar possible studies include the precipitation of aluminum and iron phosphates for phosphate removal; precipitation of calcium carbonate in lime-softening processes; and precipitation of carbonates, sulfates, and silicates in recirculating cooling systems, heat exchangers, or ammonia-stripping towers.

*Phosphate, *Chemical precipitation, *Computers, *Model studies, Calcium, Carbon dioxide, Waste water treatment

Phosphate precipitation, Calcium phosphate

F084
PREDICTIVE MODEL FOR PHOSPHORUS IN LAKES,

Snodgrass, W. J., and O'Melia, C. R.

North Carolina University,
Chapel Hill,
Department of Environmental Sciences and Engineering.

Environmental Science and Technology, Vol. 9, No. 10, p 937-944, October, 1975. 7 fig, 3 tab, 41 ref.

An input-output model has been developed to predict phosphorus in lakes. The purpose of this research was to formulate and verify such a model for decision-making in management of lake water quality and to determine causes for inverse relationships between several lake conditions and mean lake depth. A few previous models, both empirical and conceptual, were described. The proposed model showed excellent agreement between observed and predicted average phosphorus concentrations for lakes with a wide range of hydraulic detention times (one to 700 years) and mean depths (14 to 313 meters). Presently, the model is limited to lakes with aerobic hypolimnetic waters. Minimum data required for prediction are phosphorus loading, hydraulic loading, and mean depth. The model can be applied to determining the eventual response of a lake to a proposed change in phosphorus inputs, such as the result of removal from detergents or by sewage treatment. The verification of the model's temporal response characteristics indicates that it can be used to predict the rate of changes which will occur in a lake following a change in P inputs. Thus, the model might be used to evaluate management alternatives such as mixing, hypolimnetic aeration, and hypolimnetic withdrawal. Experimental evidence for a depth-dependent exchange of heat and materials across the thermocline region of lakes as well as for natural flocculation of particulate matter in the lakes was also presented.

*Lakes, *Mathematical models, *Phosphorus, *Water management (applied), Water quality control, Sewage treatment, Waste disposal, Model studies, Detergents

F085
A NOTE ON OPTIMAL TAXATION OF ENVIRONMENTAL SPILLOVERS,

Pestieau, P.

Cornell University,
Ithaca, New York.

Journal of Environmental Economics and Management, Vol. 2, No. 1, p 34-39, September, 1975. 7 ref.

An economic model was formulated to determine the environmental policy for the situation where industrial pollution can be reduced partially by effluent taxation and partially by a publically owned waste treatment plant. The setting for the policy decision was a competitive economy with constant returns to scale technology and commodity taxation. In the case of increasing returns to public abatement, an effluent tax set at marginal user cost does not generate enough revenue to finance the facility. Thus, the problem lies in finding additional revenue most efficiently. This problem is discussed in the framework of commodity taxation. The cost of pollution control is shifted to the consumers, and taxes derived on efficiency grounds might prove to have a regressive incidence which can be avoided only by considering social welfare functions.

*Model studies, *Tax rates, *Industrial wastes, *Economics, Waste water treatment, Treatment facilities, Water pollution control, Pollution abatement

Effluent taxes, Economic models

F086
FACTORS AFFECTING ADOPTION OF LAND TREATMENT OF MUNICIPAL WASTE WATER,

Carlson, G. A., and Young, C. E.

North Carolina State University,
Raleigh,
Department of Economics and Business.

Water Resources Research. Vol. 11, No. 5, p 616-620, October, 1975. 1 fig, 3 tab, 21 ref.

Land treatment of municipal waste water has proven successful in the southern part of the United States. A model of local waste treatment by land application is presented. A demand curve for land treatment was derived, using data collected from 125 cities, assuming a profit-maximizing framework. Outputs of a waste treatment facility were considered to be volume of waste water, degree of waste removal, and potentially marketable by-product. The dependent variable was adoption or non-adoption of land treatment and coefficients were estimated by non-linear regression. It was determined that the price of by-products (water), price of capital, required degree of treatment, and local construction cost contribute to an increase in adoption of land treatment. The volume of river flow, rainfall, and effluent volume have a negative effect on adoption, while land prices are not significant. The cost analysis suggests that municipal sanitary officials should try to determine what degree of treatment (BOD and nutrient removal) will be required by future state and federal regulations in order to better plan their treatment alternatives.

*Waste water treatment, *Municipal wastes, *Model studies, Economics, Statistical methods, Costs, Analytical techniques

Land application, Land treatment, Cost analysis

F087
COMPUTER CONTROLS PUT 'WASTE' WATER TO GOOD USE,

Horstkotte, G. A., Jr., and Niles, D. G.

The American City and County, Vol. 90, No. 10, p 55-56, October, 1975.

Computer control is used in reclaiming up to 30 mgd of effluent from the Central Contra Costa Sanitary District, California, sewage treatment facility. The reclaimed effluent will be sold to the Contra Costa Water District, who will then sell it to refineries, chemical industries, and power plants for use as cooling and process water. The effluent must be a high quality, essentially free of contamination and nutrients. The waste water reclamation plant will achieve this quality with a process of high-lime treatment, biological nitrification, biological denitrification, and mixed media filtration. The water quality is maintained by a direct digital control (DDC) system, one of the first of its kind in the United States. All process functions are controlled and monitored directly. One part of the dual computer acquires data and controls process functions while the other handles off-line functions and provides standby capability. Only about 88% of the manpower needed for a comparable conventionally controlled facility is required to operate the Contra Costa plant. The 30 mgd plan will eventually be expanded to a 120 mgd capacity. Laboratory and pilot studies are underway, and energy recovery by burning some of the municipal solid waste of the area is a major priority for future construction.

*Computers, *Control systems, *Waste water treatment, *Sewage treatment, Treatment facilities, California, Water reuse, Economics

F088
EFFICIENCY OF POLLUTION TAXATION AND MARKET STRUCTURE,

Lee, D. R.

Colorado University,
Boulder.

Journal of Environmental Economics and Management, Vol. 2, No. 1, p 69-72, September, 1975. 5 ref.

The performance of a uniform pollution tax in achieving a given level of pollution at least cost is examined. A lack of attention has been given to market organization in discussing externalities and pollution control. It was demonstrated that unless all polluting firms have the same elasticity of demand at their equilibriums, imposing the same per-unit pollution tax on each firm will not result in a minimum cost reduction in pollution. The same pollution reduction could be achieved at a lower cost with increased reduction by firms with high demand elasticity and less reduction by firms with low demand elasticity. In general, least-cost abatement will not result from a pollution tax uniformly applied. The situation where differing degrees of market power exist among polluters and the possible patterns of pollution taxes to achieve least-cost abatement are discussed.

*Water pollution control, *Tax rates, Pollution abatement, Costs, Industrial wastes, Economics

Market structure

F089
DESIGN VALUE IN, WASTE OUT,

Dell'Isola, A. J.

McKee-Berger-Mansueto, Incorporated,
Washington, D. C.

The American City and County, Vol. 90, No. 10, p 51-54, October, 1975.

The application of value engineering (VE) techniques to waste water treatment plant construction is described. The purpose of a VE or value analysis method is to detect and eliminate unnecessary costs. A multidisciplinary team of engineers, chemists, public officials and others work on defining basic versus secondary functions. These are then related to cost and "worth". Cost modelling involves ranking the systems, subsystems, and special equipment of a project from highest to lowest in terms of total cost per unit. The unit costs are then broken down into functional areas such as electrical, mechanical, structural. VE potential is determined and selection of project equipment is based on a cost/worth ratio. If this ratio is greater than two or three, poor value and high costs are indicated. Part of this analysis includes determining total or life-cycle costs. Value engineering was performed for a Plainville, Connecticut, proposed advanced waste water treatment plant. After a week-long workshop with consulting engineers and the Connecticut Department of Environmental Protection representatives, the town identified a potential first-cost savings of over $1.4 million, from the original $7.5 million cost estimate. Savings were found by consolidating several process operations under one roof, by improving effluent quality with fewer filter elements, and by using all-weather-rated equipment instead of structural protection for pre-treatment facilities.

*Engineering, *Waste water treatment, *Construction costs, *Treatment facilities, Analytical techniques, Equipment, Water quality control, Tertiary treatment

*Value engineering, Cost effectiveness

F090
'THAMESWATER' HELPS IN THE FIGHT FOR A CLEANER RIVER,

Dover, C.

Surveyor, Vol. 146, No. 4345, p 12, September 19, 1975.

The Thames Water Authority has commissioned a new research vessel to monitor the Thames River water quality. Called the 'Thameswater', this launch will observe the effect that the five sludge disposing vessels are having on the river. In the past year it has been found that the Thames is relatively clean and that fears that it may become anaerobic are unnecessary. The typical pattern of dissolved oxygen for the river is high at Richmond, declining to a minimum at Crossness, and rising to almost fully saturated at Southend. It was also found that the Thames has been on the average two degrees cooler than in past years, probably due to a reduction in electricity consumption and thus a lower load of heat pollution from power stations. The 'Thameswater' is used by teams from the Thames Water Authority chemical laboratories and biological research facilities. It can automatically monitor the river temperature, its chloride content (for salinity), and alkalinity and ammonia and nitrate levels. An abundance of aquatic life and clean seaweeds have indicated that the river is generally healthy.

*Water quality control, *Rivers, *Aquatic life, Sludge disposal, Pollutant identification, Dissolved oxygen, Powerplants, Water temperature, Alkalinity

Thames River, Water authorities

F091
BULL RUN SAFE YIELD STUDY,

Beyerlein, D.

Hydrocomp Simulation Network Newsletter, Vol. 7, No. 3, p 1-4, April 1, 1975. 3 fig, 3 tab.

An assessment of the probable yield of the Bull Run Watershed reservoir system was performed for the Bureau of Water Works of the City of Portland, Oregon. The concept of expected yield was evaluated with a probabilistic approach. Many flow traces were generated, each with the same statistical properties as the observed sequence and its own specific storage requirement. The large number of traces used made it possible to compute the probability that a given storage would be adequate to meet a specific demand. Three demand sequences for the period 1970 to 2020 were tested. Eight alternative combinations of reservoirs and reservoir modifications were identified. The combinations provided a range of total active storage from 45,350 to 126,450 acre-feet. The storage probability curves generated allowed the Bureau to determine what reservoir storage is needed to meet the various demand sequences. The Bureau can also decide the maximum economic storage capacity of the Bull Run reservoir system and then calculate the costs and benefits of seeking additional water customers.

*Water supply, *Model studies, *Mathematical models, Reservoirs, Water demand, Water resources, Water management (applied), Administration

F092
THE DISPERSED FLOW MODEL FOR A BIOLOGICAL REACTOR AS APPLIED TO THE ACTIVATED SLUDGE PROCESS,

Turian, R. M., Fox, G. E., and Rice, P. A.

Syracuse University,
Syracuse, New York,
Department of Chemical Engineering and Materials Science.

The Canadian Journal of Chemical Engineering, Vol. 53, No. 4, p 43'-437, August, 1975. 9 fig, 3 tab, 13 ref.

The axial dispersion model of Levenspiel is the best available model for describing mixing in a conventional activated sludge aeration basin. Combining this mixing model with a suitable expression for waste removal kinetics provides a description of the activated sludge process. The equations presented are applied to the analysis of the activated sludge process. BOD and biomass profiles are calculated for activated sludge reactors using Monod kinetics and assuming that growth parameters are uniform over the length of the tank. Plug flow or complete mixing are considered as limiting cases of the overall model. Approximate perturbation solutions are calculated for these two limiting situations. The perturbation solutions are compared with the solutions of numerically integrated equations over a range of parameters corresponding to real activated sludge systems. Smaller values of the dispersion number result in larger BOD removals. As the dispersion number decreases, the steepness of the increase in the biomass concentration increases, and the shape of concentration vs. reactor length profiles is increasingly dependent on the saturation constant. Dispersion number values greater than one are desirable to prevent upsets in activated sludge tanks resulting from shock loading. Activated sludge operation is more stable at higher values of the dispersion number because the tank conditions are more uniform and less affected by changes in the feed stream.

*Activated sludge, *Kinetics, *Model studies, Mathematical models, Waste water treatment, Mixing, Biomass, Growth rates, Organic loading, Sewage treatment, 673

F093
APPLICATION OF KINETIC MODELS TO THE CONTROL OF ACTIVATED SLUDGE PROCESSES,

Keyes, T. W., and Asano, T.

Journal Water Pollution Control Federation, Vol. 47, No. 11, p 2574-2585, November, 1975. 9 fig, 6 tab, 13 ref.

Mathematical models are convenient to use to describe the kinetics of activated sludge processes. Applicable kinetic models are presented which were used for operational modifications of the City of Bozeman, Montana, Wastewater Treatment Plant. The study determined the average waste water loadings and activated sludge plant performance from August through December, 1973, and the feasibility of increasing the waste water flow rate to the activated sludge system without degrading the final clarifier effluent quality. Process modifications, based on the analysis, were implemented in June and July of 1974. The mean cell residence time is an important factor in the control of activated sludge process performance. A higher BOD5 removal was achieved by reducing cell residence time, thereby producing a younger, more active biomass in the aerator. The change in the sludge age must be balanced out with the secondary clarifier performance and the optimum combination of BOD5 removal in the aerator and the clarifier sludge settleability. Based on the kinetic models employed, it was decided that the waste water flow rate to the activated sludge system should be increased from 1.1 to 2.1 mgd. The increased loadings had a beneficial effect on the effluent TSS concentrations. The reduction in TSS increased from 65% to 75%. The kinetic models permitted the institution of near full capacity conditions at the Bozeman facility.

*Activated sludge, *Kinetics, *Model studies, *Waste water treatment, Treatment facilities, Control systems, Mathematical models, Biomass, Biochemical oxygen demand, Suspended solids, Flow rates, Sewage treatment, Montana

Sludge age, Bozeman (Mont)

F094
PROCESS CONTROL AS AN AID TO POLLUTION CONTROL,

Steven, W.

Water Pollution Control, Vol. 74, No. 5, p 516-523, 1975. 2 append.

Process control as an aid to pollution control as applied to the Carbarns works in the Burgh of Motherwell and Winshaw, England, is discussed. The design philosophy of an automatic control system must include two elements: accumulation of information must be such that fluctuations in the system must be recorded in considerable detail and number, enabling accurate conclusions on plant performance; and this information must be programmed into the system to automatically allow for such fluctuations. Three types of information required are physical factors, chemical and biological factors, and early warning factors. The system described is hooked up by telemetry to two other distant treatment facilities. The system consists of a four section control console, logic and recorder cabinets, three typewriters, an analytical 12-point recorder, a tape punch, a computer and auto-dialing equipment. Operating procedures are outlined. It was found, after three months of operation of this system, that designs can always be improved. Plant selection requires careful selection in choosing such a sophisticated system. A detailed description of the physical outline and mechanical details of the plant is required for the software designers. In addition, it is necessary that the methods of operation of the plant should be carefully outlined at the programming stage.

*Pollution abatement, *Water pollution control, *Data collections, *Control systems, Telemetry, Treatment facilities, Computer programs, Computers, Automatic control, Water works, Equipment, Instrumentation, Waste water treatment, Water treatment

*Process control, Analytical recorders

F095
THE LOG PEARSON TYPE 3 DISTRIBUTION AND ITS APPLICATION IN HYDROLOGY,

Bobee, B.

Quebec University, Quebec, Canada,
National Institute for Scientific Water Research.

Water Resources Research, Vol. 11, No. 5, p 681-689, October, 1975. 3 fig, 4 tab, 10 ref.

The log Pearson type 3 (LP) distribution is used extensively in hydrology particularly for flood frequency analysis. A mathematical and statistical study was conducted which defined the flexibility and limitations of this distribution. The method of fitting the LP distribution as proposed by the Water Resources Council consists of the application of the method of moments to the logarithms of observed data. However, when using this method a bias may be introduced since the method does not use the moments of the observed values. A new method for fitting the distribution is proposed which makes use of a better understanding of the properties of the distribution. The mathematical portion of the study illustrated the great variety of forms of the LP distribution and justified the importance of the distribution in the analysis of hydrological data. An upper boundary was identified for cases where the distribution of the logarithms is negatively skewed (when the logarithmic base is less than zero). The statistical portion determined the relationship between the coefficient of variation and the coefficient of skewness; these are both independent of the location parameter. The proposed method of fitting produces a better fit for extreme sample values and is better suited for the determination of events with a high return value. A more complete comparison of the two methods should be performed using Monte Carlo simulation techniques.

*Model studies, *Mathematical studies, *Statistical methods, *Flood forecasting, Flood frequency, Hydrology, Hydrologic data

Log Pearson type 3 distribution

F096
DYNAMICS OF NITRIFICATION IN THE ACTIVATED SLUDGE PROCESS,

Poduska, R. A., and Andrews, J. F.

Tennessee Eastman Company, Kingsport.

Journal Water Pollution Control Federation, Vol. 47, No. 11, p 2599-2619, November, 1975. 18 fig, 5 tab, 26 ref.

A dynamic model was developed for the nitrification in the activated sludge process that relates the time-varying effluent concentrations of ammonium, nitrite, and nitrate nitrogen to the influent nitrogen concentration and flow rate. The model was used to determine design criteria and operation methods to improve the efficiency of nitrification. The model consists of five differential equations based on substrate and organism mass balances. The reactor process modeled was a single-stage, completely mixed aeration basin followed by a solids-liquid separator. Experimental verification of the model was obtained by step and impulse forcings of influent nitrogen concentrations and flow rates for continuous flow, completely mixed nitrifying suspended culture reactors operated at a pH of 7.2, temperature of 23 C, hydraulic retention time of 11 hr, and 10 day old sludge. The steady-state results of the model satisfactorily predict the level of nitrification reported in the literature for full-scale and pilot plant activated sludge plants. Model simulations have shown: the degree of nitrification in an activated sludge process depends on the sludge age; a plug flow reactor system will produce an effluent with a lower ammonium concentration than a completely mixed reactor for sludges younger than 5 days; the efficiency of nitrification is lower for dynamic operation than for steady-state operation when the sludge age is less than 5 days; and, a plug flow reactor is more resistant to toxic pulses with respect to maintaining nitrification than a completely mixed reactor.

*Activated sludge, *Waste water treatment, *Model studies, Mathematical models, Nitrification

Completely mixed reactors, Plug flow reactors

675

F097
REVIEW OF THE MODELS OF TIDAL WATERS,

Hinwood, J. B., and Wallis, I. G.

Monash University,
Clayton, Australia,
Department of Mechanical Engineering.

Journal of the Hydraulics Division, ASCE, Vol. 101, No. HY11, p 1405-1421, November, 1975. 1 ref, 1 append.

A classification scheme for water and waste movement models previously had been defined based on the number of spatial dimensions and reference frames. Eulerian, Lagrangian and constant upstream volume frames of reference were used. Hydrodynamic, kinematic and transport models were examined for each classification. A review of these models is undertaken. Zero-dimensional models were defined to estimate the seriousness of a waste discharge problem. They can only be transport models. One-dimensional Eulerian models give accurate descriptions of waste concentration and movement in long estuaries. One-dimensional hydrodynamic models predict tidal elevations reasonably well. One-dimensional transport models predict longitudinal waste concentration. For one-dimensional non-Eulerian models, the frame of reference moves up and down the estuary with the tide, keeping a constant volume of water above it. Only transport models have been developed for this frame of reference. These models simulate water movement more closely than do Eulerian models. Two dimensional plan view models represent the longitudinal and lateral movement of wastes. Hydrodynamic models in this class can either include nonlinear acceleration or not. Tide heights were predicted very accurately with this model. These models work best for irregular estuaries with coriolis and wind circulations. Two dimensional side elevation models are limited to narrow estuaries that are well mixed laterally. Three dimensional models allow the complete spatial distribution of the waste field to be predicted. This type of modeling can be expected to develop rapidly in the next few years.

*Mathematical models, *Tidal waters, Water quality control, Water quality, Hydrodynamics, Estuaries, Waste water (pollution)

*Tidal water modeling, Kinematic modeling, Estuarine modeling, Transport modeling, Waste movement models

F098
MULTI-PROCESS BIOLOGICAL TREATMENT MODEL,

Christensen, D. R., and McCarthy, P. L.,

CH2M Hill, Incorporated,
Bellevue, Washington.

Journal Water Pollution Control Federation, Vol. 47, No. 11, p 2652-2664, November, 1975. 2 fig, 7 tab, 9 ref.

A computerized biological treatment model, BIOTREAT, in Fortran IV language, uses stoichiometry, thermodynamics, and kinetics for the study of a number of biological processes in suspended growth in a complete mix reactor. It is primarily concerned with activated sludge, aerated lagoons, nitrification, denitrification, sulfate reduction, anaerobic or aerobic digestion, and anaerobic ponds. Sludge yields, oxygen requirements, nutrient needs, and methane production, which usually have to be input with coefficients, are determined by BIOTREAT from the mass and energy relationships of the compounds involved in the biochemical reactions of the treatment process. The program utilizes a catalog of half-reactions that can be input when a run is made; this allows the modelling of a number of processes. In this manner, the engineer only has to be familiar with one model in order to study a wide variety of treatment applications. A special half-reaction and subroutine are available for modelling with unique organic wastes since all sources of waste cannot be included in the catalog. Furthermore, increasing quantities of information about a process can be input, and more accurate output results will be obtained.

*Biological treatment, *Mathematical models, *Computers, *Kinetics, Activated sludge, Aeration, Nitrification, Denitrification, Aerobic digestion, Anaerobic digestion, Waste water treatment, Mixing, Energy

*BIOTREAT, Stoichiometry, Aerated lagoons, Sulfate reduction

F099
IDENTIFICATION IN NONLINEAR DISTRIBUTED PARAMETER WATER QUALITY MODELS,

Yih, S. M., and Davidson, B.

Iowa State University, Ames,
Department of Chemical Engineering.

Water Resources Research, Vol. 11, No. 5, p 693-704, October, 1975. 9 fig, 6 tab, 47 ref.

Problems in studying estuarine water pollution simulation arise when the model is subjected to time varying waste runoff and discharges at fixed or nonfixed locations or durations. New and efficient algorithms for the identification of individual unknown parameters in nonlinear estuarine water quality models were developed and the most efficient model was applied using prototype measurements. The differential equation and the initial and boundary conditions are stated. Three algorithms studied were the steepest descent method, the conjugate gradient method and Marquandt's method. An important parameter that must be estimated is the longitudinal dispersion coefficient. Theoretical formulations can be used, relating it to known tidal characteristics, or a steady state model can be fitted to observed salt or dye concentration data through trial and error. A new approach was used in which the coefficient was identified from an intra-tidal, time varying, variable area, salinity intrusion model using both simulated data and real data from the Delaware River estuary. Extensive simulations run on all three models showed that Marquandt's method was the most efficient. The disadvantage was the substantial amount of computing time that the method took. It remained effective even in the presence of moderate amounts of noise but the number of data locations did show some effect. The identification method of estimating the longitudinal dispersion coefficient compared well with the actual monitored salinity data from the estuary. This methodology can be generalized to estimate other estuarine quality parameters.

*Water quality, *Computer models, Estuaries, Intertidal areas, Water pollution, Water quality control, Mathematical models, Delaware River

Nonlinearity, Steepest descent method, Conjugate gradient method, Marquadt's method, Longitudinal dispersion coefficient, Differential equations, Identification method

F100
THE RIVER THAMES FLOOD DEFENCE BARRIER,

Horner, R. W.

London, England,
Rivers Branch,
Department of Public Health Engineering.

The Public Health Engineer, Vol. 17, p 120-124, September, 1975. 5 fig, 4 ref, 1 append.

Statistical analysis performed on high and low water levels of the Thames Estuary near London indicated that the probability of bank full conditions and serious flooding has increased considerably. Cost analysis of the effects of flooding on the area showed that an improvement of the standard defense was needed. Various schemes and the one actually selected are considered. The area considered has a high population, a considerable amount of industry with high capital investment and numerous public facilities, indicating that a major flood could have a large impact for years to come. High tide can be caused by a number of factors, such as low air pressure, or depression, wind stress on the water surface and the normal gravitational pull of the sun and moon. If these factors occur together for a long period of time, flooding can occur. Alternative solutions to the traditional methods of flood control fell into three main categories: attenuation of the inflowing tide by a structure that could partially close the Estuary; complete closure of the Estuary; and reduction of water levels by overspilling the excess water into low lying marshes. The most feasible was found to be a structure capable of either complete or partial closure of the Estuary. Investigations were undertaken to choose a suitable site and design. Navigational openings were provided and the gates could be closed in 15 minutes, using hydraulic cylinders. Studies showed that other benefits of this structure could be derived, such as improvement of water quality, water storage for water supply, power generation, navigation and amenity and recreation uses.

*Flood control, *Flood protection, Cost analysis, Statistical methods, Estuaries, Tides, Wind tides, Floodgates, Flood routing, Navigation, Water supply, Water storage, Water quality, Hydraulic gates

F101
GROUND-WATER RECHARGE SIMULATION,

Amar, A. C.

New South Wales University,
Duntroon, Australia,
Military Studies.

Journal of the Hydraulics Division--ASCE, Vol. 101, No. HY9, p 1235-1247, September, 1975. 6 fig, 17 ref.

The two-dimensional hydrodynamic behavior of recharge of an unconfined aquifer was formulated, based on nonlinear potential theory. The solution of this equation was presented based on the Accelerated Liebman Method. The flow was assumed to be unsteady and the aquifer medium was assumed to be saturated, homogeneous, and isotropic. The validity of currently known analytical solutions for the various linearized cases was also examined. Comparisons were made between the dimensionless theory curves obtained and the pertinent experimental data. A correlation between classical D-F theory and potential theory demonstrated that, except under severely restricted values of certain parameters, the nonlinear potential theory may provide the answer for a correct description of the problem relating to the hydrodynamics of recharge. This analysis offered improvement in its accuracy and helped to explain some of the observed deviations between the known mathematical solutions and experimental data for several cases. The method developed may be applied to regional flow models involving non-homogeneous and anisotropic solids, to systems with complicated geometry, and to three-dimensional cases.

*Model studies, *Recharge, *Groundwater movement, *Groundwater recharge, *Simulation analysis, *Mathematical studies, Equations, Aquifers, Flow, Analytical techniques, Hydrodynamics, Hydrologic aspects

Accelerated Liebman Method, Nonlinear potential theory

F102
A MATHEMATICAL MODEL FOR PHOSPHORUS MOVEMENT IN SOILS,

Shah, D. B., Coulman, C. A., Novak, L. T., and Ellis, B. G.

Michigan State University,
East Lansing,
Department of Chemical Engineering.

Journal of Environmental Quality, Vol. 4, No. 1, p 87-92, January/March, 1975.
3 fig, 16 ref.

Because land treatment of municipal and industrial effluents is increasing as a disposal method, an understanding of the movement of phosphorus in the soil is needed. A model was developed to describe the quantitative behavior of water and phosphorus. It was shown that the water saturation profile travels faster than the phosphorus profile. The water distribution between irrigation in the Barriered Landscape Water Renovation System, constructed by Michigan University, had a negligible effect on phosphorus movement. The model formulated included material balance equations for water in the soil pore spaces, phosphorus in the liquid phase, and adsorbed phosphorus on the soil. Equations were solved numerically to simulate the phosphorus concentration profiles in the soil solution and in the soil as functions of depth for an operating waste disposal system. This type of model with predictive capacity is useful for the design of waste water irrigation sites which must be designed to minimize phosphorus leakage to the groundwater.

*Waste water treatment, *Waste disposal, *Groundwater movement, *Phosphorus, *Mathematical models, Model studies, Water pollution sources, Irrigation, Equations, Simulation analysis, Soil mechanics

Land application

F103
CHARACTERIZATION OF USAGE AND WASTEWATER IN ROADSIDE REST AREAS,

Peddada, A. V.

Dissertation Abstracts International B., Vol. 36, No. 4, p 1888, October, 1975.

Five highway rest areas in different geographical locations were evaluated in terms of traffic, water consumption, sewage production, and sewage strength. Data was collected and processed by computer. Statistical analyses were used to develop design equations for water supply and sewage treatment design parameters. The equations developed may be used to design future rest area sewage and water supply systems.

*Sewage treatment, *Water supply, *Statistical analysis, *Equations, *Computers, Highways, Water consumption, Design criteria, Planning

Highway rest areas

F104
NONPOINT SOURCE MINERAL WATER QUALITY MODEL,

Betson, R. P., and McMaster, W. M.

Tennessee Valley Authority,
Knoxville, Hydraulic Data Branch.

Journal Water Pollution Control Federation, Vol. 47, No. 10, p 2461-2473, October, 1975. 6 tab, 27 ref.

Water quality models are needed for a variety of reasons including: accounting for the differences in watershed characteristics that will cause differences in water quality; predicting the natural water quality regime for streams so that pollution impacts may be assessed; making more comprehensive use of data that are collected; and, to assist states in preparing reports describing the nature and extent of nonpoint sources of pollution and recommendations for programs to control each category as required by PL 92-500. The development and application of a first-generation, regionalized, non-point source mineral water quality model is discussed. The model was developed based on the natural conditions found in the Tennessee Valley. The model uses existing data and provides a modeling capability for current problems. It can be easily modified and augmented as additional data becomes available. The development and calibration of the model are explained. Twelve watersheds across the Tennessee Valley were selected to test the model. The results obtained showed that the model is capable of simulating within the range of values typically observed for a constituent. The average absolute simulation error for 24 samples was within plus or minus 30% for many constituents and was above 60% for only two mineral constituents. The model is an efficient way to represent water quality information; information from many analyses is contained in 15 pairs of equations that may be stored in a computer to provide an automatic natural water quality simulation capability.

*Model studies, *Water quality, *Monitoring, Mathematical models, Simulation analysis, Water quality control, Tennessee Valley Authority

Nonpoint source pollution

F105
PHOSPHORUS MODEL OF MUSKEGON WASTEWATER SYSTEM,

Enfield, C. G., and Leach, L. E.

United States Environmental Protection Agency,
Ada, Oklahoma,
Water Quality Control Branch.

Journal of the Environmental Engineering Division-ASCE, Vol. 101, No. EE6, p 911-916, December, 1975. 6 fig, 5 ref.

A model has been developed for the Muskegon County, Michigan, land application waste water treatment system, simulating vertical movement and sorption of phosphorus. The purpose of the investigation was to predict how the system would function with respect to the applied phosphorus based on: proposed operating conditions, the constraints of the mathematical model, and laboratory measurements of the kinetics of phosphorus sorption by Muskegon soils. Computer analysis provided six profiles (three operating conditions) for the responses of Rubicon Sand and Roscommon-Au Gres Sand to waste water application. For each soil type, predicted applications of phosphorus concentrated at 5.0 mg/liter at a rate of 0.0298 cm/hr, 5.0 mg/liter at a rate of 0.0595 cm/hr and 3.56 mg/liter at a rate of 0.0595 cm/hr were modelled. From the predictions, Rubicon sand appeared to be more effective in removing phosphorus. For the model, it was assumed that waste water would be applied at a constant rate throughout the year and that the influence of vertical variability of the soils was not considered. If the Muskegon system were to be operated under these model constraints, no problems in phosphorus removal should occur for the first 30 years of operation.

*Model studies, *Waste water treatment, *Phosphorus, Laboratory investigation, Kinetics, Soils, Sorption, Water pollution effects, Computers, Waste disposal

Land application, Phosphorus removal, Muskegon (Mich)

F106
THE CONTROL OF WASTE WATER FLOW OF NEW TOWN INTO THE TREATMENT PLANT (Danchi gesuishorijo no ryunyusui no seigyo ni kansuru kenkyu),

Hiraoka, M., Murakami, T., Yamamoto, I., Horii, Y., and Ishimaru, K.

Mizushori Gijutsu, Vol. 16, No. 9, p 851, 1975.

The control of domestic waste water flow into a treatment plant by utilizing a balancing tank was studied. The amount of waste water discharged varied over time, causing an unstable waste water treatment operation. A balancing tank to regulate the input amount of waste water into the treatment plant gave more stable operation. The tank could be installed either to intercept all waste water flow before feeding into the treatment plant (thus passing a constant amount of waste water into the plant) or to intercept only excess waste water flow (and discharge this flow when the normal levels were lower). Using the second method, COD and SS concentrations at the final precipitation pool were measured and compared with those concentrations without the balancing tank installation. Without the balancing tank, the COD value varied from 100 to 1100 mg/liter and SS from 30 to 1370 mg/liter. With the balancing tank, the COD and SS values were relatively constant at 50 mg/liter and 10 mg/liter, respectively.

*Control systems, *Waste water treatment, *Domestic wastes, Treatment facilities, Chemical precipitation, Chemical oxygen demand, Suspended solids, Tanks, Model studies

*Balancing tank, Waste water flow

F107
MODEL ECOSYSTEM STUDIES OF LEAD AND CADMIUM AND OF URBAN SEWAGE SLUDGE CONTAINING THESE ELEMENTS,

Lu, P-Y., Metcalf, R. L., Furman, R., Vogel, R., and Hassett, J.

Illinois University,
Urbana,
Department of Entomology.

Journal of Environmental Quality, Vol. 4, No. 4, p 505-509, October/December, 1975. 2 fig, 5 tab, 20 ref.

A laboratory model ecosystem was constructed to investigate the environmental fate of lead from lead chloride and cadmium from cadmium chloride by direct application of two types of soils or by using sewage sludge as the source of heavy metals. The model used a terrestrial/aquatic interface with silica sand, Bloomfield soil (sandy loam) and Drummer soil (silty clay loam) as substrates. Applications of lead, cadmium, and sewage sludge were made directly to the substrates. Lead and cadmium were mobilized and incorporated into the food chain organisms in proportion to the sorption capacity of the substrate and were highest in silica sand and lowest in the Drummer soil. With sewage sludge application, there was a significant mobilization and transfer of cadmium, copper, lead and zinc into the food chains of alga, daphnia, mosquito larva, snail, and fish. Cadmium in particular had a negative effect on various organisms in the model ecosystem. It was suggested that if urban sewage sludge is to be applied to croplands, steps to prevent the sludge from trace metals contamination should be taken.

*Model studies, *Laboratory investigations, *Lead, *Cadmium, *Sewage sludge, *Heavy metals, Metals, Soils, Agriculture, Crops, Ecosystems, Sludge disposal, Water pollution effects

*Land application

F108
MODEL PLANT FOR BIOLOGICAL REMOVAL OF PHOSPHATE FROM COMMUNAL WASTE WATER, III. BIOLOGICAL PHOSPHATE REMOVAL FROM COMMUNAL WASTE WATER PRELIMINARILY CLEANED BY A BIOLOGICAL PROCESS (MODELLVERFAHREN ZUR BIOLOGISCHEN ENTPHOSPHATUNG KOMMUNALER ABWAESSER, III. BIOLOGISCHE ENTPHOSPHATUNG BIOLOGISCH VORGEREINIGTEN KOMMUNALEN ABWASSERS ENIES KALERWERKES),

Bringmann, G., and Kuehn, R.

Gesundheits-Ingenieur, Vol. 96, No. 10, p 249-251, October, 1975. 1 fig, 6 tab.

A model plant for the biological removal of phosphate from biologically pretreated municipal waste water has been developed. The purified waste water, with a neutral pH value stabilized by means of carbon dioxide, passes through four aerated biological filters. Ferrous chloride is added at a P:Fe ratio of 1:1.36 relative to the ferrous chloride demand of the complex plant. At an initial phosphate ion concentration of 10.42 mg/liter, the phosphate removal efficiency amounted to 99.93%, corresponding to a residual phosphate concentration of 0.007 mg/liter. The phosphate removal is performed by microorganisms which oxidize ferrous ions to ferric ions. Ammonium nitrogen does not interfere with the process.

*Biological treatment, *Phosphate, *Nutrient removal, Waste water treatment, Carbon dioxide, Filters, Municipal wastes, Microorganisms, Model studies, Pilot plants

Phosphate removal, Ferrous chloride

F109
CIRIA ASSESSES ITS MODEL WAY TO TREAT SEWAGE,

Surveyor, Vol. 146, No. 4353, p 16, November 14, 1975.

The progress of a project to create a mathematical model for optimizing cost-effectiveness of sewage treatment plants was discussed by the Construction Industry Research and Information Association (CIRIA) of Great Britain. The model was developed two years ago in order to aid the designer of a sewage treatment facility in choosing the combination of processes and the size of units which best suit the required degree of purification while keeping costs at a minimum. The present assessment will test the process modules, locate and correct errors in the original computer program, check the mathematical optimization procedures, and undertake sensitivity analyses. The original model used only conventional sewage treatment techniques, but the completed model will include new processes in its cost evaluation. Details of over 100 test runs of the model have been reported in a Report entitled, "Cost-effective sewage treatment--an assessment of the prototype model." In this report, the conclusions of designers and researchers are stated, and general benefits of the assessment period are summarized.

*Model studies, *Mathematical models, *Sewage treatment, *Treatment facilities, *Costs, Research, Computers, Waste water treatment

Cost-effectiveness models, Construction Industry Research and Information Association (CIRIA)

F110
INTERACTION OF ACTIVATED CARBON WITH DISSOLVED OXYGEN,

Prober, R., Pyeha, J. J., and Kidon, W. E.

Case Western Reserve University,
Cleveland, Ohio,
Chemical Engineering Department.

AIChE Journal, Vol. 21, No. 6, p 1200-1204, November, 1975. 7 fig, 2 tab, 11 ref.

Experiments using manometric and packed column techniques to determine the rate and extent of dissolved oxygen sorption by activated carbon were performed. Several types of activated carbons were tested--granular and powdered, virgin and reactivated. All the carbons sorbed 150 to 600 micromoles/g of dissolved oxygen after run times of up to 1700 hours, but still not at equilibrium. Rate data conformed to a sorption model limited by intraparticle diffusion. The sorption of dissolved oxygen increased acidic surface oxides by about 200 microeq/gram; oxidation reactions were postulated, accounting for 10 to 50% of the sorbed oxygen. The data provide a new base line for oxygen uptake in the presence of organic solutes, bacterial growth, or catalytic oxidation processes.

*Activated carbon, *Model studies, *Dissolved oxygen, *Laboratory investigations, Waste water treatment, Manometers, Sorption, Oxygen

Packed columns, Rate data

F111
A DISCUSSION OF A NEAR FIELD DISPERSION MODEL FOR SLUDGE DISCHARGES TO COASTAL WATERS,

Rittall, W. F.

Environmental Protection Agency, Corvalis, Oregon, Coastal Pollution Branch, Pacific Northwest Environmental Research Laboratory, National Environmental Research Center.

In: Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, May 21-22, New Brunswick, New Jersey, Rutgers University, p 435-476. 21 fig, 6 tab, 6 ref.

Computer simulation techniques can provide a detailed description of the sequence of events that occur after sludge discharge, enhancing the interpretation of physical mechanisms. The application of this simulation technique for the problem of sewage sludge discharges is demonstrated. The depth of penetration of the waste cloud, the dilution, and the depositional characteristics of settleable and floating solids are discussed and related to pertinent Federal Regulations governing ocean dumping. Three separate methods of discharge are described by the model: instantaneous, pumped and wake releases. One liquid and a maximum of eight distinct solid or particulate phases can be chosen from to characterize the waste. Three transport modes are long term diffusion, collapse, and convective descent. Results were evaluated in terms of predictive capabilities and applications to the general problem of permit evaluation, site monitoring surveys, and compliance with regulatory criteria. It is hoped that this model can be of significant value since there is no other procedure or model available to the regulatory programs which provides such a detailed degree of analysis.

*Dispersion, *Mathematical models, *Sludge, *Sludge disposal, Computer models, Computer programs, Sewage sludge, Sewage, Federal government, Regulations, Disposal, Ocean, Evaluation, Permits, Analysis, Dispersion

*Coastal waters, Computer simulation, Ocean disposal, Transport modes

F112
TRANSPORT PHENOMENA APPLIED TO SLUDGE DEWATERING,

Kos, P., and Adrian, D. D.

Dorr-Oliver Corporation,
Stamford, Connecticut.

Journal of the Environmental Engineering Division-ASCE, Vol. 101, No. EE6, p 947-965, December, 1975. 6 fig, 2 tab, 19 ref.

A mathematical model for flocculent porous media has been developed to describe a theory of sludge dewatering. The increase of concentration in sludges was shown to be due to the increase of effective pressure, which is the major parameter governing the concentration changes of sludge during the dewatering process. A partial differential equation was found for the application of the mathematics of transport phenomena in porous media to the evaluation of effective pressure changes. In describing a sludge dewatering process, the physical characteristics of the coefficient of linear compressibility and the hydraulic conductivity must be measured. Voluminous and flocculent sludges are generated in waste water treatment and water treatment plants. The deformation of the matrix of these sludge solids should be similar to the measured sludge, and this model should be valid for all flocculent sludges and suspensions. This model can also be used to describe the performance of sludge dewatering equipment in cases where the equipment performance was not clearly described by the specific resistance concept.

*Sludge treatment, *Dewatering, *Filtration, Sludge disposal, Equipment, Mathematical models, Model studies, Hydraulic conductivity, Pressure, Waste water treatment, Water treatment

F113
DESIGN GRAPHS FOR ACTIVATED SLUDGE PROCESS,

Mynhier, M. D., and Grady, C. P. L.

Cornell Howland, Hayes and Merryfield--Clair A. Hill and Associates, Reston, Virginia.

Journal of the Environmental Engineering Division-ASCE, Vol. 101, No. EE5, p 829-846, October, 1975. 9 fig, 4 tab, 31 ref, 1 append.

Design graphs facilitating consideration of the interaction between the aeration tank and the final settler, and its effect on total cost in the completely mixed activated sludge (CSTR) process, are considered. Equations describing the continuous stirred tank reactor (CSTR) are described. The mean cell residence time is an important parameter in describing the performance of the CSTR. The Monod kinetic model, relating the microorganism growth rate to maximum growth rate, saturation constant, and substrate concentration, and the first order approximation in which the saturation constant is much greater than the substrate concentration are given. Through these equations the substrate concentration is related to the mean cell residence time. Parameters used in this design are estimated in this study. In order to determine the mean residence time, the equations can be used, but there are times when it would be advantageous to graph the solutions. Three dimensionless constants are defined: the dimensionless substrate concentration; the dimensionless specific decay rate; and the dimensionless mean cell residence time. These are plotted for the Monod model and the first order approximation. In order to design the settler, settler performance equations are derived from a subsidence flux model and an overflow rate equation. These equations are also plotted. To illustrate the use of the graphs, the treatment of a soybean processing waste is presented as an example.

*Activated sludge, *Graphical analysis, *Graphical methods, *Design, Microorganisms, Growth rates, Kinetics

Monod kinetic model, Continuous stirred tank reactor, Completely mixed activated sludge process, Mean cell residence time, Substrate concentration, Subsidence flux model

F114
DIMENSIONLESS INLET HYDROGRAPH MODEL,

Ragan, R. N., Root, M. J., and Miller, J. F.

Maryland University, College Park, Department of Civil Engineering.

Journal of the Hydraulics Division-ASCE, Vol. 101, No. HY9, p 1185-1195, September, 1975. 5 fig, 1 tab, 11 ref, 1 append.

Techniques for synthesizing storm hydrographs for urban areas from computer based models use a series of submodels to simulate the behavior of the various components. These are known as linked system design models. A large core computer is required for their proper use, but, in some cases this is economically unfeasible. A method for estimating the hydrograph entering an inlet or catch basin that would be simple enough to allow hand calculations and retain good agreement with the computer model is developed. This model, known as a dimensionless inlet hydrograph, is based on the Maryland Linked System Design Model (MLSDM). Results obtained with this model are very similar to those produced with other linked models. One hundred numerical experiments were carried out with this model in order to provide synthetic hydrographs for an array of conditions. Analysis of this data showed that the peak discharge was influenced most by the slope and the percentage imperviousness of the watershed for the conditions studied. A graphical analysis performed on the data showed that a single curve can be used to represent the rising side of the hydrograph but three curves must be used for the recession side, in order to keep good agreement with the MLSDM. Generally, numerical results show good agreement with results generated with the computer model. Best agreement occurs between magnitudes of the peak discharge and hydrograph volumes. Agreement is weak with respect to detail.

*Hydrographs, *Hydrograph analysis, Mathematical models, Computer models, Graphical analysis, Storms, Storm runoff

F115
PHOSPHORUS MOVEMENT IN SOILS: THEORETICAL ASPECTS,

Novak, L. T., Adraino, D. C., Coulman, G. A., and Shah, D. B.

Cleveland State University, Cleveland, Ohio, Department of Chemical Engineering.

Journal of Environmental Quality, Vol. 4, No. 1, p 93-99, January/March, 1975. 4 fig, 5 tab, 15 ref, 1 append.

Phosphorus has been identified as one of the nutrients that causes eutrophication in lakes and streams. Land treatment is being considered as a method of removing P and other nutrients from waste waters. A model of P movement in soils is discussed and compared with existing transport models, developed to describe chromatographic and ion exchange processes. The background of transport models is presented. The model described in this study is an adsorption-desorption model which can handle unsteady state flow under unsaturated and saturated flow conditions. The steady flow P model was developed for the following conditions: one-dimensional system in the direction of flow; isothermal system; constant water content, bulk dry solid density and pore velocity; and nonideal flow described by a dispersion coefficient. The model equations are presented. Numerical solutions for the P model were obtained by an implicit numerical technique. Comparisons of various adsorption-desorption models under both plug flow and nonideal flow are graphically illustrated. Application of the P model to describe adsorption in soils results in a shock layer which was less than four centimeters in thickness in all cases considered. If the ratio of the adsorption rate to bulk convective transport rate is large, small shock layers result. The converse is also true. No mathematical theory has been developed to prove that desorption causes a shock layer. Numerical solutions are necessary.

*Phosphorus, *Soil water movement, *Soils, Flows, Waste water treatment, Mathematical models, Adsorption, Unsteady flow, Steady flow, Saturated flow, Unsaturated flow, Numerical analysis

Desorption, Steady flow phosphorus model, Transport models, Plug flow, Nonideal flow

F116
THE USE OF A DIGITAL MODEL IN THE MANAGEMENT OF THE CHALK AQUIFER IN THE SOUTH DOWNS, ENGLAND,

Nutbrown, D. A., Downing, R. A., and Monkhouse, R. A.

Central Water Planning Unit,
Reading, Great Britain.

Journal of Hydrology, Vol. 27, p 127-142, 1975. 8 fig, 1 tab, 7 ref.

The use of a digital model in the management of the chalk aquifer in the South Downs, England, has helped in the decision-making process. Over the years the demand for groundwater in the area of South Downs had steadily increased until it represented a significant proportion of the average annual infiltration. In view of this, consideration had been given to the problem of determining the most efficient method of developing the groundwater resources in the aquifer, particularly bearing in mind its coastal boundary and the fact that it is dissected by tidal rivers with the consequent risk of saline intrusion. In the model, the effects of different abstraction rates and pumping regimes on groundwater levels were tested. The model describes the effects in mathematical terms. The groundwater-flow equations are solved numerically using a digital computer.

*Model studies, *Aquifers, Groundwater, Infiltration, Groundwater movement, Hydrology, Computers, Water management (applied)

Digital models

F117
SCREENING MODEL FOR CONJUNCTIVE-USE WATER SYSTEMS,

Hamden, A. S., and Meredith, D. D.

Harza Engineering Company,
Chicago, Illinois.

Journal of the Hydraulics Division-ASCE, Vol. 101, No. HY10, p 1343-1355, October, 1975.
2 fig, 4 tab, 16 ref, 2 append.

Linear and dynamic programming has been used to analyze conjunctively operated water resource systems. A minimum cost flow network model is presented for use for planning conjunctively operated groundwater and surface water systems. The out-of-kilter algorithm can be used as a solution technique. The Kaskaskian River Basin is used in this study. The water supplies in this Basin are from groundwater and surface reservoirs. Fifty year projections indicate that neither source will be enough on its own and that an integrated plan is needed. The basin, consisting of 115 towns, was grouped into ten regions. A network of 175 supply and use nodes and 805 arcs representing rivers and pipelines was analyzed by computer. Five assumptions of surface and groundwater use, evaporation and water flow were also stated. Flow was conserved at each node in the network. The out-of-kilter algorithm is used to determine the minimal cost flow. Three alternatives were studied and compared to the solution solved on the assumption of a safe yield basis.

*Linear programming, *Water resources, *Model studies, Algorithms, Costs, Rivers, Surface waters, Groundwater

F118
THE WATERSHED APPROACH TO UNDERSTANDING OUR ENVIRONMENT,

Woolhiser, D. A.

United States Department of Agriculture,
Fort Collins, Colorado.

Journal of Environmental Quality, Vol. 4, No. 1, p 17-21, January/March, 1975.
2 fig, 25 ref.

Current approaches used in modeling the agricultural watershed include the formal, mathematical model and the material, representational model. Formal models allow predictive statements to be made; material models provide interpretation of three-dimensional flow in a porous medium with surface runoff, but are simpler to work with than the real system. Formal models consisting of sets of partial differential equations can be simplified by reducing their dimensionality to one space, by treating groundwater flow as a steady-state problem, and by using "lumped" or compartment models to eliminate spatial variability. Nonhomogeneities or spatial variability can be included in a material model. The model would first include spatial variability and then would be modified so that such variability would be averaged in some sense. Models are used in the decision-making process; therefore, they must include only the most important of subprocesses involved or they will become unduly cumbersome. When a model is developed for one purpose, it cannot be used for another application.

*Model studies, Watersheds, Water management (applied), Mathematical models, Runoff, Decision making

F119
AQUIFER PARAMETER IDENTIFICATION,

Yeh, W. W-G.

California University,
Los Angeles,
Engineering Systems Department.

Journal of the Hydraulics Division-ASCE, Vol. 101, No. HY9, p 1197-1209, September, 1975. 2 fig, 2 tab, 27 ref.

The problem of an unsteady flow in an unconfined aquifer and stream interaction system, governed by a nonlinear parabolic partial differential equation, was analyzed by five different methods: quasilinearization, maximum principle, gradient method, the influence coefficient method, and linear programming. With each technique a numerical method was required in solving the governing equation. Quasilinearization and maximum principle rely upon an explicit finite difference scheme which, computationally, is conditionally stable. An implicit scheme can be utilized for the finite difference approximation of the governing equation when using either the gradient method, the influence method, or linear programming. The advantage of the implicit scheme is that it is unconditionally stable. The computer time used by each of the techniques was within seconds, and the associated costs varied from $2 to $4. All formulations and analyses presented can be modified to solve more complex problems. The rate of convergence was quite rapid, but, due to the initial estimate of the parameter, they only converge to a local minimum. The validity of the parameter identification can be tested in the field by using several sets of observations collected under different initial and boundary conditions, and results can be compared with the field observations. The corresponding errors in prediction can then be calculated.

*Model studies, *Aquifers, *Flow, *Mathematical models, Computers, Costs, Linear programming, Planning

Quasilinearization, Influence coefficient method, Parameter identification

F120
LIME-INDUCED REACTIONS IN MUNICIPAL WASTEWATERS,

Merrill, D. T., and Jorden, R. M.

Colorado University,
Boulder,
Department of Civil and Environmental Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 12, p 2783-2808, December, 1975. 11 fig, 29 ref.

If steady-state soluble constituent concentrations can be attained within reasonable times in lime-treated raw waste systems, then the interaction of lime and the constituents of municipal waste water can be described through equilibrium-based mathematical models. The models can interpret system reaction phenomena and identify limitations that designers and treatment plant operators must face. Experiments were carried out with raw, degritted waste water and additions of lime of 150, 250, and 350 mg/liter so that data might be obtained over the pH range of effective phosphate precipitation. The waste water and lime samples were analyzed for soluble Ca sub t, CO sub 3t, PO sub 4t, and Mg sub t, and the results recorded on a graph. Then the equilibrium behavior of lime-treated waste at simulated conditions was calculated by application of water chemistry theory. Analyses indicated that total phosphate residuals are insensitive to initial waste concentration at pH values greater than or equal to 10, suggesting that pH could be a good control parameter in regard to PO4 removal. Lime treatment will neither soften water nor eliminate salt efficiently. Lime requirements and the mass of chemical sludge produced are highly dependent on the initial waste CO sub 3t concentration. Lime requirements run 10 to 50 percent higher than theoretically predicted because lime only partially dissolves. Increasing the ratio PO sub 4t:CO sub 3t in the initial waste water may, in some cases, produce substantial processing economies.

*Model studies, *Waste water treatment, *Lime, Chemical precipitation, Municipal wastes, Mathematical models, Phosphate

F121
FOR WHICH LOAD SHALL COMMUNAL PURIFICATION PLANTS BE DIMENSIONED? (FUER WELCHE BELASTUNG SOLLEN KOMMUNALE KLAERANLAGEN BEMESSEN WERDEN),

Gruhler, J.

Wasserwirtschaft-Wassertechnik, Vol. 25, No. 11, p 364-368, 1975. 2 fig, 9 ref.

Considerations in the dimensioning of municipal biological waste water treatment plants are presented. The waste water discharge for which these treatment plants should be dimensioned is determined from measurements of discharge and organic matter load, and the long-term evaluation of these parameters should be considered. The purification efficiency is determined by the water quality of the recipient. The fluctuations in the quantity of the incoming waste water should be considered mainly in the dimensioning of the post-treatment basin rather than in that of the aeration basin. The minimum residence time in the post-treatment basin should not be shorter than 1.5 hours. Biological waste water treatment plants should be dimensioned for a daily BOD load in kg/day of water discharged into the effluent, and not for hourly peaks, as short-term BOD peaks represent no hazard for the recipient.

*Biological treatment, *Municipal water, *Treatment facilities, *Model studies, Organic compounds, Water quality control, Biochemical oxygen demand

Dimensioning, Post-treatment basins, Waste discharge

F122
NOMOGRAMS FOR SIMPLIFIED HYDRAULIC DIMENSIONING OF WASTE WATER DUCTS (NOMOGRAMME ZUR VEREINFACHTEN HYDRAULISCHEN BEMESSUNG VON ABWASSER-KANAELEN),

Szalay, M.

Gas-und Wasserfach-Wasser/Abwasser, Vol. 116, No. 9, p 415-417, September, 1975. 3 fig.

A simplified nomogram for the dimensioning of waste water ducts, obtained by an integration of filling curves and the usual dimensioning nomograms, is described for circular and egg-shaped duct sections. The new nomogram makes it possible to obtain the dimensioning data in a single step. The nomograms developed for circular and egg-shaped sections permit the determination of the necessary pipe diameter, the mean water flow velocity, the water depth, and the time required for the water to clear a 100 meter-section, as a function of the discharge rate and of the gradient of the sewer.

*Model studies, *Waste water treatment, *Pipes, *Flow velocity, Sewers, Mathematical studies, Hydraulics

*Nomograms, Waste water ducts

F121
FOR WHICH LOAD SHALL COMMUNAL PURIFICATION PLANTS BE DIMENSIONED? (FUER WELCHE BELASTUNG SOLLEN KOMMUNALE KLAERANLAGEN BEMESSEN WERDEN),

Gruhler, J.

Wasserwirtschaft-Wassertechnik, Vol. 25, No. 11, p 364-368, 1975. 2 fig, 9 ref.

Considerations in the dimensioning of municipal biological waste water treatment plants are presented. The waste water discharge for which these treatment plants should be dimensioned is determined from measurements of discharge and organic matter load, and the long-term evaluation of these parameters should be considered. The purification efficiency is determined by the water quality of the recipient. The fluctuations in the quantity of the incoming waste water should be considered mainly in the dimensioning of the post-treatment basin rather than in that of the aeration basin. The minimum residence time in the post-treatment basin should not be shorter than 1.5 hours. Biological waste water treatment plants should be dimensioned for a daily BOD load in kg/day of water discharged into the effluent, and not for hourly peaks, as short-term BOD peaks represent no hazard for the recipient.

*Biological treatment, *Municipal water, *Treatment facilities, *Model studies, Organic compounds, Water quality control, Biochemical oxygen demand

Dimensioning, Post-treatment basins, Waste discharge

F122
NOMOGRAMS FOR SIMPLIFIED HYDRAULIC DIMENSIONING OF WASTE WATER DUCTS (NOMOGRAMME ZUR VEREINFACHTEN HYDRAULISCHEN BEMESSUNG VON ABWASSER-KANAELEN),

Szalay, M.

Gas-und Wasserfach-Wasser/Abwasser, Vol. 116, No. 9, p 415-417, September, 1975. 3 fig.

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*Model studies, *Waste water treatment, *Pipes, *Flow velocity, Sewers, Mathematical studies, Hydraulics

*Nomograms, Waste water ducts

F123
OPTIMAL DESIGN MODEL FOR WASTE WATER COLLECTION SYSTEM (II)
(Gesuidokan kiyo keikaiu no saitekika moderu to sono oyo (II)),

Yamada, K.

Ritsumeikan Daigaku Rikogaku Kankyusho Kiyo, No. 28, p 17-28, 1975. 13 fig, 9 tab, 18 ref.

A three dimensional model to determine the optimal waste water collection system has been proposed. The model was constructed on the assumptions that the number of arcs was 25, the length of each arc was 250 m or 500 m, the number of rankings for the excavation depth was 10, the width of each ranking was 25 cm or 50 cm, the maximum flow rate was 2.5 m/sec, the minimum flow rate was 0.6 m/sec, and the rate of waste water generation was 2 liters/sec/10,000 sq m. The model employed ten different factors, each of which had two different values assigned. These factors and their assigned values were: x-directional gradient of the upper stream, 0.5 and 2.0; x-directional gradient of the lower stream, 0.5 and 2.0; y-directional gradient of the upper stream, 0.5 and 2.0; y-directional gradient of the lower stream, 0.5 and 2.0; additional flow rate increase factor, 1.0 and 1.2; additional main sewage line construction cost increase factor, 0.0 and 0.2; flow rate variation, 0.0 and 0.2 Q; groundlevel variation, 0.0 and 0.1 m; construction cost variation, 0.0 and 0.1 C; and excavation depth of the final node, 4 m and 2 m. Using sixteen combinations of values for the ten factors, the total construction costs for each combination were calculated; the range of costs was between $555,300 and $1,984,000. An analysis of variance was made for the calculated results to see the effect of the factors on the derived construction costs. The factors of groundlevel variation, x-directional gradient of the lower stream, and y-directional gradient of the lower stream contributed 84% of the variation in construction costs.

*Model studies, *Economics, *Construction costs, *Waste water treatment, Mathematical models, Variable costs

F124
FORMULATION AND USE OF PRACTICAL MODELS FOR RIVER QUALITY ASSESSMENT,

Hines, W. G., Rickert, D. A., McKenzie, S. W., and Bennett, J. P.

U. S. Geological Survey, Willamette River-Quality Study,
Portland, Oregon,
Water Resources Division.

Journal Water Pollution Control Federation, Vol. 47, No. 10, p 2357-2370, October, 1975. 5 fig, 3 tab, 18 ref.

A river quality model is a predictive tool for river basin planning and management provided that the model is properly formulated, calibrated, and verified on sound scientific knowledge of the river basin's physical conditions. Sometimes a complexity of physical conditions or limited knowledge prevent formulation of a reliable model. In such cases semiquantitative descriptive studies can provide insights into river processes and variables, and can provide a basis for future models. Runoff and water temperature patterns, channel morphology, and time and space variabilities can help to identify critical time periods and reaches of a river. Models must be based on separate, reliable sets of data. Periodic grab sample data commonly generated by pollution monitoring and surveillance programs are not suitable for model calibration or verification. Results of model production runs must be translated into understandable formats to be of any use. To attain this goal, modelers and users must be in constant communication.

*Water quality control, *Rivers, *Runoff, *Model studies, Water temperature, Monitoring, Water pollution control, Forecasting

F125
FLOOD PLAIN MAPPING,

Linsley, R. K.

Hydrocomp,
Palo Alto, California.

Simulation Network Newsletter, Vol. 7, No. 4, p 1-8, May 15, 1975. 5 fig, 1 tab, 10 ref.

In order to set premiums for flood insurance, continuous simulation computer models are specifying the various levels of probability of flooding. Conventional hydrology in flood plain mapping has the problems of limited data, inadequacy of the design rainfall approach, and limitations from assumptions and simplifications. Continuous simulation transforms a long series of rainfall data into streamflow by an algorithm representing the hydrologic processes. With sufficient rainfall data, the output is continuous without assuming any specific design rainfall. Probability analysis of this data defines flood levels throughout the watershed without invoking the assumptions inherent in use of backwater methods. The Hydrocomp Simulation Program is adapted to a particular watershed by adjusting parameters such as overland flow slope and length, extent of vegetative cover, and stream pattern in the watershed and area. For ungaged watersheds the parameters are estimated from adjacent gaged watersheds. Where conditions within the watershed vary substantially, it is subdivided into segments with a separate set of parameters for each segment. The data analysis is obtained from the National Weather Service and the U. S. Geological Survey.

*Simulation analysis, *Flood forecasting, *Hydrology, Rainfall, Data collections, Model studies, Watershed management, Streamflow forecasting, Computers

F126
WATER REUSE: A FLEXIBLE AND EFFICIENT MANAGEMENT ALTERNATIVE FOR MUNICIPAL WATER SUPPLY,

Dwarkin, D. M.

Butler University,
Indianapolis, Indiana,
Holcomb Research Institute.

Water Resources Research, Vol. 11, No. 5, p 607-615, October, 1975. 6 fig, 8 tab, 18 ref.

A computer model was designed to simulate the fixed schedule of planned expansion of water supply sources in Colorado Springs. It was then compared with an alternate model that provided no reuse capacity at the beginning of the simulation and made the addition of potable supply systems contingent on a short-term decision based on monitoring reservoir level, streamflow, and water use. In both the plan and the alternative, renovated water was restricted to nonpotable uses. Both were simulated for three streamflow series differing in frequency, timing, and drought durations. In addition, three population series were used. For every assumed population and streamflow condition simulated, the alternative was a less costly method of supply than the plan. The expense of the plans arose from the cost of treating effluent for reuse when water from the potable supply system was available in sufficient quantities to meet the demands of all users, and from the investment in conventional and reuse facilities which could have been delayed. The alternative plan provided processing for water only when the supply in storage was low. Additions to conventional capacity would be delayed until parameters measuring the supply and use of water indicated such a need.

*Water reuse, *Model studies, *Computers, Water supply, Potable water, Monitoring, Streamflow, Simulation analysis, Colorado, Water management (applied)

F127
PROBLEM OF SELECTING INDICES FOR THE RELIABILITY OF WATER SUPPLY AND SEWER NETWORKS, PART I (Zacadnienie wyboru wskaznikow niezawodnosci systemow wodociagowych i kanalizacyjnych. czesc I,),

Kloss, H., and Roman, M.

Gaz, Woda i Technika Sanitarna, Vol. 49, No. 10, p 305-307, October, 1975. 1 fig.

Definitions and models of reliable and efficient water supply systems and their elements were discussed. Supplying data on the over-all and precise workings of technical objects from an economic viewpoint, the Central Bureau of Standards in Warsaw, Poland, furnished the indicators of reliability properties. According to the Bureau, all technical objects could be divided into reparable and irreparable categories. The definition of the former was an object which could be repaired for damages, and the definition of the latter was an object for which no repairs could be anticipated, even in the event of reversible damage. The category in which the object under discussion will be included is often decided by the user. In accordance with Soviet standards, reliability of an object is evaluated by the total number of such properties as suitability, durability, reparability, resistance to storage, and preservation of inherent functional properties. The Central Bureau of Standards elaborated on these definitions. On their basis of the properties indicated, a number of mathematical equations were developed in order to calculate the probability of proper function of technical objects under various conditions.

*Model studies, *Water supply, Economics, Repairing, Equipment, Design criteria, Mathematical models

Poland, Evaluation

H001
THE CAPE COD WATER PROGRAM,

Sinnot, J. A.

Commonwealth of Massachusetts,
Boston, Massachusetts

Journal of the New England Water Works Association, Vol. 88, No. 3, p 238-247, September, 1974. 2 fig, 13 ref.

Research on the chemical quality of ground and surface waters has been conducted on Cape Cod for the groundwater aquifer of Barnstable County, Massachusetts. Five deep holes were drilled in 1973, giving the thicknesses of permeable layers and indicating high iron content in all deep water. Water was pumped from three deep well mud holes and it was concluded that: all water pumped and tested was fresh water, background chloride was 25 ppm; only one aquifer exists under Cape Cod; most usable water occurs before a depth of 160 feet below M.S.I.; and Fe and Mn at greater depths are potential problems. Recommendations include further study of the problem of ocean outfall sewage disposal as opposed to on land treatment and its impact on groundwater quality.

*Groundwater, *Water quality, *Aquifers, Iron, Sewage disposal, Land treatment, Groundwater management, Hydrologic aspects

Cape Cod (Massachusetts), Ocean disposal

H002
HYDRAULIC MODEL STUDY OF A LARGE-CAPACITY SETTLER IN A WATER CAPTURE SYSTEM (BADANIA HYDRAULICZNE MODELU DUZEGO OSADNIKA NA UJECIU WODOCIAGOWYM),

Petrozolin, W.

Gaz, Woda i Technika Sanitarna, Vol. 18, No. 7, p 232-235, 1974.

Studies were conducted on a hydraulic model of a large capacity settler in the Warsaw sewage system in order to investigate the feasibility of improvements in their old settler built between 1924 and 1928. The scale selected was 1:25, the length of the model 32 m, the width 13 m, and the depth 12 to 16 cm. The model was installed in conditions similar to actual settlers. The studies were conducted in August, September, and October 1971; June 1972; and November 1972. The parameters studied were: the surface of the water in the settler, the intensity of the flow, division of flow through three openings, the wind, and the existence or absence of partitions impeding or changing flow direction. Wind proved to be the major significant factor. Conclusions were reached by comparing mean velocities in selected partitions of the model with mean theoretical velocities. At maximum velocities from 1.42 m/min to 0.19 m/min, the mean velocities varied from 0.59 to 0.12 m/min, the mean active depths constituted 23% to 77% of the total depth, and the mean actual velocity was 1.3 to 4.9 times higher than the mean theoretical velocity. The flow time varied from 2 to over 9 hours during various days or times of the day, influencing the maximum velocity and settling of the wastes. The disturbing action of the wind regulated the settler's activity, but efficiency could be increased by only four percent.

*Sewage systems, *Hydraulic models, Flow rates, Efficiency, Wind

Warsaw, Poland, Settlers, Water capture

H003
MANAGEMENT OF WASTE FLUIDS IN SALAQUIFERS,

Kazmann, R. G., Kimbler, O. K., and Whitehead, W. R.

Louisiana State University,
Baton Rouge, Louisiana,
Department of Civil Engineering

Journal of the Irrigation and Drainage Division, ASCE, Vol. 100, No. IR4, p 413-424, December, 1974. 7 fig, 15 ref.

A long term method of waste disposal is the injection of wastes into deep aquifers that are presently filled with saline water. No management as such, of these saline aquifers has been attempted; the prevailing attitude was that this is a safe and permanent method. However, it has been found that the period of containment may vary, depending on whether the waste fluid is denser than the native fluid and upon the usable volume of pore space downdip from the injection well field to the boundary or the synclinal axis of the salaquifer. Future waste injection projects should carefully study the regional geology of a target aquifer in terms of thickness, dip, faults that obstruct regional flow, as well as parameters of the native fluid such as porosity, permeability, and storativity. As long as the density of the native salaquifer fluid is smaller than that of the waste to be injected, and the aquifer is not horizontal, containment of the wastes is almost certain. However, if the injected fluid is lighter than the native fluid, a system of careful monitor wells should be maintained to observe fluid movements. Pressure monitoring of the salaquifer is also required, for osmotic effects may lead to unanticipated increases in the pressure within the target aquifer. Equations and a procedure for computing the required information in monitoring an aquifer are given. Additional work in the field of miscible displacement is being continued for management of wastes disposed of by injection into salaquifers, both in laboratory and field studies.

*Wastes disposal, *Saline water, *Aquifers, Waste management, Monitoring, Wells, Water injection

Salaquifers

H004
GROUNDWATER POLLUTION BY WASTE DISCHARGE (LA POLLUTION DES EAUX SOUTERRAINES PAR LES DECHARGES),

Barres, M.

Techniques et Sciences Municipales, Vol. 69, No. 6, p 365-371, 1974. 2 fig, 3 tab, 22 ref.

The problem of groundwater contamination due to infiltration and leachout from waste dumps and sanitary landfills is discussed, and guidelines for the selection of the site of landfills are presented. Waste dumps and sanitary landfills may present a hazard of groundwater contamination by inorganic and organic materials, but very little hazard of biological contamination. Sanitary landfills should be established in areas protected from inundation and with low groundwater table level, or where an aquifer has good self-purification possibility. Therefore, porous aquifers are generally more suitable than karstic and fissurized rockbed. If the self-purifying capacity of an aquifer is limited, the would-be waste disposal site should be made impervious by applying a layer of clay or plastic film. Also, sites with low groundwater flow rates are preferable.

*Groundwater pollution, *Contamination (water), *Aquifers, *Landfills, Flow rates, Waste disposal

Waste discharge, Leachout, Sanitary landfills

H005
SITE EVALUATION AND DESIGN OF SEEPAGE FIELDS,

Healy, K. A., and Laak, R.

Connecticut University, Storrs, Connecticut, Department of Civil Engineering

Journal of the Environmental Engineering Division, Vol. 100, No. EE5, p 1133-1146, October, 1974. 7 fig, 2 tab, 15 ref.

A two part study was conducted to develop improved seepage site evaluation techniques and improved methods of designing seepage fields. Conclusions formed from a literature review are: there is little difference in the final or long-term acceptance rate between a soil that is flooded continuously or the same soil that is flooded intermittently; a relatively stable long-term acceptance rate is indicative of a balance between bacterial growth and decomposition of clogging matter within the active interface zone; in general, the more permeable the soil, the further the suspended and dissolved materials can move into it; a hydraulic head of approximately one foot of water will permit efficient operation of a seepage field; effluents containing smaller amounts of material allow a higher long-term acceptance rate; and the results of previous investigations are consistent if the permeability of the soil used and the hydraulic head maintained are considered. The long-term acceptance rate varies from about 0.3 gpd/sq ft for a soil with a permeability of 0.0002 ft/min to about 3.0 gpd/sq ft for a soil with a permeability of 0.1 ft/min. In many cases it is the hydraulic conductivity of the ground surrounding the seepage field that controls the size of the field required. Reliable techniques for site evaluation of soil permeability, depth to water table, and depth to impervious strata are given and a chart for designing seepage fields based on this information is presented. It is possible to design and construct seepage fields that will operate successfully for extended periods if accurate measurements are made of soil permeability, position of the water table, and position of any impervious strata and if the loading rate is kept below a certain value that is a function of the soil permeability.

*Waste water disposal, *Seepage, *Sewage disposal, Percolation, Penetration, Permeability, Seepage control, Drainage, Groundwater movement, Hydraulics, Hydraulic conductivity, Effluents, Impervious soils

*Seepage fields

H006
DETERMINATION OF TRACE QUANTITIES OF BORON IN SURFACE WATER BODIES AND IN DRINKING WATER (SPURENBESTIMMUNG VON BOR IN OBERFLACHENGEWASSERN UND TRINKWASSERN),

Graffmann, V. G., Kuzel, P., Nosler, H., and Nonnemacher, G.

Chemiker-Zeitung, Vol. 98, No. 10, p 499-504, 1974. 1 fig, 3 tab, 20 ref.

The boron concentration was determined in about 300 samples of surface water and in about 240 samples of drinking water taken from places distributed throughout the Federal Republic of Germany and West-Berlin. All of the investigated 110 surface water samples from the river Rhine and samples from most of the other rivers had a boron concentration up to a maximum of 0.25 mg B/liter. Only very small rivers which are known to transport a large amount of waste water showed a significantly higher boron concentration. None of the about 240 samples of drinking water had a higher boron concentration than 0.25 mg B/liter. The boron concentrations which were found in surface and drinking water of the Federal Republic of Germany are in the lower range as compared to boron concentrations which have been determined in surface water, ground water and drinking water of other European and of non-European countries.

*Boron, *Water quality, *Sampling, Potable water, Surface waters, Waste water, Hydrology

Rhine River, Germany, Europe

H007
DUMPS: A POTENTIAL THREAT TO OUR GROUNDWATER SUPPLIES,

Weddle, B., and Graland, G.

Solid Waste Management Programs,
Environmental Protection Agency,
Effects and Analysis Branch, Systems Management Division

Nation's Cities, Vol. 12, No. 10, p 21-25, 42, October, 1974.

Sanitary landfill criteria have been reexamined by the Office of Solid Waste Management Programs. Actual damage shows that groundwater resources may be threatened by pollutants leaching from dumps. Two examples cited were a dump in Connecticut which caused the wells of about 50 subdivision homes to be contaminated, and a more serious case in Delaware in 1972 where a dump in an abandoned sand and gravel pit allowed an underground plume of leachate to envelop one well field of a water company serving 80,000 people. Remedial measures in both cases were costly. The official definition of sanitary landfill includes application of daily cover, no burning, waste not placed directly into groundwater, and no visible pollution of surface water. However, the problem of leachates entering unseen into groundwater is complex. Leachate forms when water percolating through solid waste flushes out compounds and other products of decomposition. Site characteristics for determining safe sanitary landfill depend upon evaluation of: depth from the bottom of the fill to the maximum height of groundwater; direction and flow rate of groundwater; present and future groundwater demands; analysis of underlying soils and geology including texture, permeability, structure, and stratigraphy; topography related to surface drainage; and net infiltration. Communities should plan for disposal capacity for at least five years into the future. Existing sites should be monitored to avoid costly cleanup measures.

*Sanitary fill, *Landfills, *Waste disposal, *Groundwater, Contamination, Wells, Waste dumps, Leachates, Costs, Surface water, Drainage, Planning

Land disposal

H008
WATER-TREATMENT SLUDGE FILTRATION STUDIES,

Hawkins, F. C., Judkins, J. F., Jr., and Morgan, J. M.

Auburn University,
Auburn, Alabama,
Department of Civil Engineering

Journal of the American Water Works Association, Vol. 66, No. 11, p 653-658, November, 1974. 4 fig, 3 tab, 37 ref.

Sludge results from the treatment of water impurities from groundwater and from surface water. This sludge must be disposed of properly. By reducing the volume of sludge, disposal may be accomplished more easily. The results of previous studies on the effects of coagulant dosage, magnesium hardness and calcium hardness on specific resistance are detailed. It was concluded that: specific resistance decreases with increasing solids concentration for alum sludge and becomes relatively constant at high solids concentration; the recycle of preformed aluminum-sulfate sludge can produce a more filterable sludge during the coagulation process; and the alum dosage yielding the sludge with minimum specific resistance corresponds approximately to the optimum dosage determined by jar test. Surface water is conventionally treated by alum to remove impurities such as clay, silt, and bacteria. Groundwater may contain hardness-causing minerals, which must be removed by lime-soda softening, before it may be put to domestic use. Treatment of the sludges, such as dewatering, and subsequent disposal is summarized.

*Sludge treatment, *Groundwater, *Surface water, *Filtration, *Water treatment, Sludge disposal, Alum, Purification, Dewatering, Waste disposal

H009
FILTRATION OF WATER WITH A HIGH IRON CONTENT,

Hult, A.

Viak AB, Consulting Engineers,
Vallingby, Sweden

Effluent and Water Treatment Journal, Vol. 14, No. 5, p 265-267, May, 1974. 3 fig, 2 tab, 2 ref.

Iron is present in groundwater in many countries in amounts greater than 0.2 ppm, or exceeding the standards for use as potable public water supply. Effects of this excess of iron are a bad taste in the water and staining of laundry. Iron is commonly removed from such water by precipitation through oxidation and filtration. Oxidation may be produced by aeration, sometimes combined with an increase of the pH value, or may be produced by adding oxidation agents other than air. Manganese in groundwater causes similar problems. Both field and laboratory investigations are necessary to determine the proper treatment for water containing iron or manganese, depending upon the character of the water. Satisfactory results were found to be obtainable by filtration of water with a very high iron content, considering the following factors: suitable gradation of the filter material; choice of suitable alkali; and oxidation during filtration.

*Groundwater, *Iron, *Manganese, *Filtration, *Oxidation, Potable water, Water supply, Public health, Water treatment, Hydrologic aspects

H010
PROBLEMS WITH EFFLUENT SEEPAGE FIELDS,

Healy, K. H., and Laak, R.

Connecticut University,
Storrs, Connecticut

Water and Sewage Works, Vol. 121, No. 10, p 64-67, October, 1974. 9 fig, 6 ref.

A rational method of designing seepage fields was investigated. Of septic tank seepage fields in Connecticut that failed, three quarters of them failed because the ground surrounding the field could not absorb the liquid, and the failures were a result of greatly reduced permeability at the soil interface due to biological activity. Design criteria were discussed for land application of an effluent. It was determined that a successful septic tank seepage field must have sufficient soil interface so that effluent application rate does not exceed from approximately 0.3 gpd/sq ft for clayey or silty soils to 0.8 gpd/sq ft for clean sands and gravels. If a potential hydraulic head of 12 inches can be provided, the sides and bottoms of trenches, beds, or pits can be used to compute this area. Also, the ground surrounding a seepage field must have sufficient hydraulic conductivity to absorb the liquid faster than it is applied. This is a difficult requirement because the hydraulic conductivity is dependent upon a number of factors; these include existing soil permeability, groundwater elevation, and impermeable boundaries. If the designer is made aware of both the hydraulic conductivity and the soil interface area, he can specify site changes such as drainage or filling and should be able to then allow construction of a seepage field for effluent disposal, applicable to specific cases of subsurface disposal of domestic septic tank effluent.

*Seepage control, *Design criteria, *Septic tanks, Effluents, Soil contamination effects, Hydraulic conductivity, Soils

Seepage fields, Land application

H011
ASPECTS OF A TRACE METAL CONTAMINATION IN THE COASTAL RIVERS OF ISRAEL,

Kronfeld, J., and Navrot, J.

Hebrew University,
Jerusalem, Israel

Water, Air, and Soil Pollution, Vol. 4, No. 1, p 127-134, 1975. 3 fig, 9 ref.

Nine trace elements of biological concern--Cr, Co, Cu, Cd, Ni, Pb, Hg, Zn, and Ag--were analyzed in sediments in a number of rivers in Israel. The purpose of the study was to determine whether significant trace metal buildup had occurred, to decide which specific metals are the contaminants, to find where pollution is occurring, and to indicate what ecological hazards are present. Input of trace metals occurs from both domestic and industrial sewage into coastal streams. Surface sands and underlying groundwaters are not isolated from each other and danger of infiltration through the soils into the groundwaters exists. Danger also exists of exposing nearshore fauna to sediments contaminated by possibly toxic trace metals. Because these rivers are shallow, they undergo periods of decline and stagnation during dry summer months, therefore increasing the possibility of concentration of deposited chemical pollutants. Four of Israel's most important coastal streams showed severe pollutant effects. Additionally, near major highways, an increase in Pb and Zn levels was measured.

*Trace elements, *Water pollution, *Rivers, Municipal wastes, Industrial wastes, Toxicity, Groundwater, Highway effects, Environmental effects

Trace metals, Contaminants, Israel, Chemical pollutants

H012
DESIGN OF SURFACE WATER OUTFALLS TO RIVERS,

Hamilton, G. S., and Haig, G. A.

Surveyor, Vol. 145, No. 4313, p 48-49, February 7, 1975. 1 fig.

A standard design for surface water drainage systems for both domestic and industrial outfalls is illustrated. The Lothians River Purification Board, Great Britain, has adopted engineering guidelines for discharging to rivers. Principles to be followed include protection of the river bed from scour, compatibility with the hydrological characteristics of the river, protection of the banks of the river, and access availability for inspection and maintenance. Once the outfall velocity of a design has been selected, the energy of the water is dissipated and scour is resisted by the construction of energy dissipators in the form of steps, by angular outflow to the river (generally 60 degrees to the river flow), and by protection of the river bed by a gabion mattress. For all outfall design calculations, the engineer must consider the hydrological regime of a specific river to determine flood frequency curve in terms of river stage at the outfall point, so as to protect the surface water system in flood conditions. The banks of rivers are protected by wing walls with stable bank protection behind the walls; access to the outfall should be provided in the form of steps for sampling and maintenance purposes.

*Surface waters, *Rivers, Guidelines, Discharge (water), Design criteria, Drainage engineering, Hydrological aspects, Flood control

*Outfalls, Lothions River Purification Board

H013
REPORT OF COMMITTEE ON SURVEY OF GROUND WATER SUPPLIES IN NEW ENGLAND,

Pittendreigh, L. M.

Journal of the New England Water Works Association, Vol. 89, No. 1, p 44-53, March, 1975.

A survey was made of municipal groundwater supplies in several New England states, in response to concern over the environmental impact of land development and a consequent increase in pollution problems. Gravel packed and gravel-walled wells were examined. The question was posed as to whether such wells have deteriorated or decreased in their capacity. Opinions were obtained on the costs and benefits of preventive maintenance programs for water wells and pumping equipment. Discussed also was treatment of groundwater for inhibiting iron and manganese problems. Public water supplies in Massachusetts, Vermont, Maine, Connecticut, and New Hampshire were discussed. In general, wells have held their quality and capacities for many years longer than previously expected. Maintenance and treatment methods varied, depending upon the population of an area and the demand for groundwater supplies.

*Groundwater, *Water supply, *Surveys, Municipal water, Wells, New England, Maintenance, Water treatment, Iron, Manganese

Gravel wells

H014
ISOTOPE HYDROLOGY 1974--A REVIEW OF THE IAEA SYMPOSIUM ON ISOTOPE TECHNIQUES IN GROUNDWATER HYDROLOGY,

Fontes, J. C., and Fritz, P.

Paris University,
Paris, France,
Laboratoire de Geologie Dynamique

International Journal of Applied Radiation and Isotopes, Vol. 25, p 1-8, 1975. 1 fig.

Highlights of the International Atomic Energy Agency Symposium on Isotope Techniques in Groundwater Hydrology are presented. Discussions dealt with environmental isotopes to be used in the studies of the infiltration process, the origin and flow of groundwater, and geothermal systems. Such methods are useful in predicting flow of pollutants discharged into the ground. Possibilities of using 39Ar and 85Kr as research tools are mentioned. The use of artificial radioactive tracers for studies of aquifer characteristics, and models for interpretation of tracer data are also being developed.

*Radioisotopes, *Tracers, Flow, Groundwater, Aquifers, Model studies, Hydrologic aspects

Pollutant flow, Groundwater flow

H015
CHANGES IN CONCENTRATION OF CERTAIN CONSTITUENTS OF TREATED WASTE WATER DURING MOVEMENT THROUGH THE MAGOTHY AQUIFER, BAY PARK, NEW YORK,

Ku, H. F. H., Vecchioli, J., and Ragone, S. E.

Nassau County Department of Public Works,
Mineola, New York

Journal of Research, U. S. Geological Survey, Vol. 3, No. 1, p 89-92, January/February, 1975. 2 fig, 2 tab, 12 ref.

The geochemical interactions of recharged water, injected by well into the Magothy aquifer at Bay Park, New York were studied. The Magothy aquifer is a major source of potable water in Nassau County, New York, and evaluation of the chemical constituents of the injected water is critical. The fates of nitrogen, phosphate, COD, and MBAS, all of sewage origin, during injection and repumping phases of the recharge of the tertiary-treated sewage were investigated. Approximately seven million gallons of reclaimed water have been injected by well into this aquifer and subsequently pumped out. It was shown that as the reclaimed water moved through the aquifer, the concentrations of certain dissolved constituents decreased as follows: total nitrogen, 7 percent; methylene blue active substances, 49 percent; COD, 50 percent; and phosphate, over 93 percent. Thus, only nitrogen remains relatively unchanged after passage through the Magothy aquifer. Half the MBAS and COD were lost to the aquifer, and most of the phosphate was lost in the aquifer or accumulated at the interface between the well and the formation face.

*Aquifer systems, *Waste water treatment, *Recharge, *Hydrogeology, New York, Groundwater, Recharge wells, Sewage treatment, Reclaimed water, Nitrogen, Phosphate, Chemical oxygen demand

*Tertiary-treated sewage, Magothy aquifer

H016
A STUDY OF CONVECTIVE-DISPERSION EQUATION BY ISOPARAMETRIC FINITE ELEMENTS,

Wang, M-S., and Cheng, R. T-S.

New York State University,
Buffalo, New York,
Faculty of Engineering and Applied Sciences

Journal of Hydrology, Vol. 24, p 45-56, 1975. 9 fig, 20 ref.

Although various contaminants are released into groundwater aquifers, the mechanisms for transport of the pollutants by the groundwater flow are all similar. A mathematic model for this flow is presented. The equation which governs the movement of impurities is a convective-dispersion one which may be solved numerically using the isoparametric, quadrilateral finite element method. The finite element technique may be used to obtain mixed boundary conditions and irregular distribution of the nodes. Calculations showed the numerical model to be an effective means of prediction for the distribution of a contaminant and for future use in groundwater pollution control.

*Groundwater, *Pollutants, *Aquifers, Mathematical models, Equations, Hydrologic aspects, Water pollution control

Groundwater flow, Convective-dispersion equation

H017
GROUNDWATER PROTECTION IN HIGHWAY CONSTRUCTION IN THE CATCHMENT AREA OF THE CITY OF BERNE AT KIESEN (GRUNDWASSERSCHUTZ BEIM AUTOBAHN IM FASSUNGSGEBIET STADT BERN IN KIESEN),

Geiser, H.

Gas Wasser Abwasser, Vol. 54, No. 9, p 385-392, September, 1974. 7 tab, 4 ref.

The effect of turnpike construction on groundwater quality in the catchment area of the city of Berne at Kiesen and measures taken to prevent groundwater contamination in the protected zone along the turnpike are described. Highway construction operations, especially those involving vibrations, caused a temporary impairment of the groundwater that had originally been of high quality and had had a general rise in both the germ count and in the appearance of Coliform bacteria. The water quality returned to normal after completion of the turnpike construction. As it was impossible to bypass the protected zone, groundwater contamination due to spilled gasoline, oil, and other chemicals will be prevented by a tight drain system for water from the turnpike into an oil separation tank, from which the cleaned water is discharged directly into a river.

*Highway effects, *Groundwater, *Construction, Oil wastes, Bacteria, Municipal water, Water pollution

Berne (Germany), Groundwater contamination

H018
MOBILIZATION OF IRON IN WATER IN THE MAGOTHY AQUIFER DURING LONG-TERM RECHARGE WITH TERTIARY-TREATED SEWAGE, BAY PARK, NEW YORK,

Ragone, S. E., Ku, H. F. H., and Vecchioli, J.

Nassau County Department of Public Works,
Mineola, New York

Journal of Research, U. S. Geological Survey, Vol. 3, No. 1, p 93-98, January/February, 1975. 2 fig, 3 tab, 8 ref.

The geochemical effects of recharging tertiary-treated sewage are being studied at the Magothy aquifer, at Bay Park, New York. The tertiary-treated sewage (reclaimed water) has been recharged by well into this aquifer intermittently since 1968. The changes in iron concentration were observed. The longest recharge test lasted 84.5 days, and allowed the reclaimed water to reach an observation well 200 feet from the recharge well. Iron concentrations of reclaimed and native water were less than 0.4 mg/liter; however, the iron samples from the observation wells approached 3.0 mg/liter. It appears that during recharge, iron is taken into solution from pyrite which is native to the well. All the chemical mechanisms by which the iron is picked up have not yet been explained.

*Recharge, *Aquifer systems, *Waste water treatment, Reclaimed water, Recharge wells, Iron, Pollutant identification, Hydrogeology, Groundwater, Observation wells

*Tertiary treated sewage, Magothy aquifer

H019
WATER QUALITY FACTORS IN DESIGNING A SEWAGE PLANT BASED ON PUBLIC DRAINAGE STATISTICAL DATA,

Ebina, S.

Gesuido Kyokai-shi, Vol. 12, No. 129, p 36, February, 1975. 9 tab, 8 ref.

Data on sewage water quality collected from over 200 sewage plants were treated statistically to design the guidelines for the future plant constructions. The average rate of waste water discharge per person in 1970 was 500 liter/day reaching to the average capacity of sewage plants of 700 liter/day person. The BOD value in untreated sewage water was almost the same in 1969 and 1970 (134 mg/liter and 125 mg/liter respectively); however, the suspended solids in corresponding years were 197 mg/liter and 175 mg/liter. The average contributions of BOD and SS to the sewage water in 1970 were 44 g/day person and 40 g/day person respectively. The stability of water treatment efficiency is related to the capacity of tanks used for treating sludge, such as conventional and step-aeration tanks. The sludge volume index value in 1970 ranged between 50 to 150. Therefore, future plants must have the tank capacity to meet a sludge volume index of 300. The digestion tanks in the future plants are estimated to have 50 to 60 percent conversion efficiency of organic materials in untreated sludges.

*Waste water treatment, *Water quality control, Sewage, Design, Treatment facilities, Suspended solids, Biochemical oxygen demand, Drainage, Data analysis

Sewage plants, Sludge volume index

H020
NONEQUILIBRIUM RIVER FORM,

Stevens, M. A., Simons, D. B., and Richardson, E. V.

Colorado State University, Fort Collins,
Department of Civil Engineering

Journal of the Hydraulics Division, ASCE, Vol. 101, No. HY5, p 557-566, May, 1975. 9 fig, 13 ref.

River channel form is the plan-view pattern and cross-sectional shape of the river channel between riverbanks. Historical evidence is presented for the discussion of rivers which are not "in regime", that is their average behaviour changes greatly over small periods of historic time. River systems with a wide range of peak-flood discharges are susceptible to changes in form. Large floods are the erosional agents which widen the river channel. Lesser floods result in channel deposits that narrow the river channel. In many cases, the average flows cause very little change in terms of altering the form of the river channel. On the basis of engineering time, the river form should be considered as the function of the sequence of flood events. An indication of the effect of a particular flood event on river form is given by the ratio of that flood's peak discharge to the average annual peak-flood discharge. If the ratio of each individual peak-flood discharge to the average annual peak-flood discharge is small, the river can be considered "in regime" and regime-type equations for river form are valid. If the ratio of some individual peak discharges to the average annual peak discharge is large, the river channel exhibits nonequilibrium form. The Gila River in Safford Valley, Arizona, is given as an example of a river exhibiting nonequilibrium form.

*River beds, *River systems, *Model studies, *Mathematical studies, Floods, River flow, River forecasting

Gila River (Ariz), River form

H021
GROUND-WATER'S ROLE IN WATER QUALITY MANAGEMENT,

Osgood, J. O.

Pennsylvania Department of Environmental Resources,
Harrisburg, Pennsylvania,
Bureau of Water Quality Management

Journal of the Hydraluics Division, ASCE, Vol. 101, No. HY3, p 517-521, March, 1975.

Federal legislation requires each state to protect the quality of its surface waters, yet this protection is stated only indirectly for subsurface waters. Because surface waters/groundwater evaluation must be integrated in water quality monitoring, the state of Pennsylvania was one of the first to design a Comprehensive Water Quality Management Plan (COWAMP) to protect groundwater as a vital resource. Over two-thirds of that state's public water supply and 99% of its private water supplies are dependent upon groundwater. The slow migration of contaminated surface water has been demonstrated to cause groundwater pollution. Examples of this are landfill leachate, leaking industrial water impoundments, gasoline spills flushed to the soil, improperly developed spray irrigation sites, and urban runoff infiltration. The COWAMP plan considers groundwater in its role as a major water supply, including new developments in well construction. Groundwater is also seen as a transporting medium for contaminant dispersion; for example gasoline spills move on top of the water table and fumes may migrate up through the soil into buildings as it flows. Additionally, activities affecting the recharge/discharge balance influence waste water treatment and related costs. COWAMP hopes to identify existing hydrogeological characteristics, to study man's impact on existing resources, and to evaluate alternatives. This involves considering areas of poor water quality, areas requiring special protection, such as recharge zones, important watersheds, large population centers, and areas where major population growth is predicted.

*Groundwater, *Water quality control, State jurisdiction, Water management (applied), Surface waters, Water pollution, Hydrogeology, Pennsylvania, Administration

Gasoline spills, Groundwater pollution

H022
HORIZONTAL GROUNDWATER COLLECTORS, HYDRAULICS AND DESIGN,

Bourgeois, P. O.

International Water Supply Limited,
Montreal, Quebec, Canada

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, Vancouver, British Columbia, p 83-106. 5 fig.

A horizontal groundwater collector or radial screen well is a large diameter concrete caisson with several screens driven laterally from its lower level outwards through sand and gravel near a stream or lake. It is used to abstract groundwater from an unconsolidated aquifer hydraulically connected to a body of surface water. A summary is presented of hydrodynamic principles which are used to determine yield, design and development of horizontal groundwater collectors. Field testing and analysis of yield includes: test drilling to establish the real extent of the acquifer and its stractigraphic characteristics; pumping tests to establish the characteristics of the aquifer such as transmissibility, permeability, and coefficient of storage which can then be used to determine the contribution of recharge of the adjacent stream; and, collector yield calculations which involve the above information plus the effectivy radius of the collector which is defined as the equivalent radius of a vertical well which under the same conditions of drawdown would produce an equivalent yield. Caisson design, lateral drain design, and screens selection are also discussed. Additional research is needed to improve on the methods described for obtaining and using the basic information required in determining the hydraulics for arriving at a collector design.

*Water supply, *Groundwater resources, *Aquifers, Wells, Hydrology, Recharge, Hydraulic design

*Horizontal groundwater collector

H023
HORIZONTAL GROUNDWATER COLLECTORS, "CANADA'S LARGEST WATER WELL",

Obst, C. E.

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, Vancouver, British Columbia, p 107-123. 8 fig.

The City of Prince George, British Columbia, initiated planning in 1970 for methods to increase their supply of potable water. The choices included: duplication of a successful and inexpensive infiltration gallery; a raw water intake from the Nechako River with a conventional water treatment plant; and, groundwater supply from the Nechako Aquifer. The installation of a single collector well with horizontal well screen was chosen as the most viable alternative. Details of the exploratory investigation (test drilling and pumping) and examination of the preliminary hydrogeology are presented. The results established that a groundwater aquifer existed, that the water quality from test pumping was acceptable, that the recharge capability of the aquifer was good and the grain size analysis of the granular soil appeared to be acceptable for a sand-free well development. The design and construction of the collector are outlined. The total project costs were $1,125,000 or less than ten cents per gallon capacity for the total capital cost of intake, treatment and pumping. It is concluded that the original objectives of Prince George of providing a safe, abundant supply of high quality potable water at the least possible cost has been achieved through the installation of a horizontal collector well.

*Water supply, *Groundwater resources, *Aquifers, Wells, Costs, Hydrology, Infiltration galleries, Water sources, Potable water, Hydrodynamics

*Horizontal groundwater collectors

H024
RUNOFF AND EROSION LOSSES,

Curnoe, W. E.

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 174-184. 6 tab, 2 ref.

Experiments were conducted to determine nutrient and heavy metal losses through runoff and erosion. The experiments began in the fall of 1972 and were conducted through the spring of 1974. The soil was a sandy clay loam with tile drains on a 2% and 6% slope. The sludge was applied in November, January, and May. Water was collected and samples taken for analysis after each runoff. Precipitation patterns and runoff events are directly related. The experimental period had a precipitation rate slightly above average. The highest nitrogen loss occured during the winter months. The sludge application time did not seem to affect the phosphorus loss which was low. The heavy metal losses were also generally low. The conclusions drawn from the experiments were that: before applying sludge, weather probabilities, snow cover, and soil conditions should be considered; application rates can increase nutrient runoff and should be restricted; and the amount of metal in the sludge has an effect on the amount of heavy metal loss.

Runoff, Erosion, Sludge, Clay loam, Nutrients, Heavy metals, Precipitation (atmospheric)

Soil conditions, Experiments

H025
BREAKTHROUGH IN SEWAGE TREATMENT--CASH, LAND, AND ENERGY SAVED,

Water Services, Vol. 79, No. 650, p 132, 140, April, 1975. 3 fig.

A method of underground treatment of both municipal and industrial effluents has been developed which will reduce the size of sewage works in half, operate them at lower costs, and produce 50% of the present amount of sludge. Called the ICI Deep Shaft Effluent Treatment Process, the basis of the system is a shaft hundreds of feet deep, partitioned into two sections. A pilot plant has been operated successfully since mid-1974 by the Northumbrian Water Authority, in Great Britain. In the process, sewage effluent enters the shaft continuously, is circulated through the sections of the shaft several times, then overflows by gravity for separation of solids. Biological oxidation is promoted by the compressed air that is also the driving force for circulating the liquid effluent. The depth of the shaft determines the efficiency of oxygen transfer. Conventional drilling techniques are used for construction of the system. In all but optimal geological conditions, the hole must be lined with either concrete or steel and the annulus between the lining and the rock must be pressure grouted or filled with cement grout, because the lining carries the load from the rock and the hydrostatic heads. ICI recommends their process as a land-saving method for use in densely populated areas, and for treatment in cold climates where slow treatment rates have been a persistent problem.

*Waste disposal, *Pilot plants, *Effluents, Sewage treatment, Biological treatment, Municipal wastes, Industrial wastes

*Underground disposal, *Deep Shaft Effluent Treatment Process, ICI (Great Britain)

H026
COST BENEFIT ANALYSIS AS DIMENSIONING BASIS OF FLOOD CONTROL MEASURES: AN EMPIRICAL REPORT (NUTZEN-KOSTEN-ANALYSE ALS GRUNDLAGE DER DIMENSIONIERUNG VON HW-SCHUTZMASSNAHMEN- EIN ERFAHRUNGSBERICHT),

Schreiber, P.

Wasser und Boden, Vol. 27, No. 2, p 27-29, February, 1975. 2 fig, 3 ref.

Computerized cost-benefit analysis as a basis for the dimensioning of flood protection measures involving 40 retention reservoirs in the Aller-Leine-Oker-Planes area, covering 16,000 sq km in West Germany, is discussed. The hydrological data are determined on the basis of simulation with respect to a limited number of flood events. The flood retention facilities will be designed for a probability of exceeding 0.02. The economic benefits of the flood control measures are calculated with respect to the potential damage areas classed as residential, industrial, commercial, farmlands, and forests. Averaged unit damages are assigned to each type of land use, taking into consideration the increase in landed property values as a result of flood protection. It is possible to determine the optimal sequence of the flood protection measures by the computer program. Flood retention reservoirs along the upper reaches of the recipients are most efficient even when they are more expensive than similar facilities along the lower reaches of the recipients.

*Computers, *Flood control, Hydrologic aspects, Reservoirs, Economics, Cost-benefit analysis, Simulation, Flood protection

West Germany

H027
ASPECTS OF HYDROLOGICAL EFFECTS OF URBANIZATION,

Journal of the Hydraulics Division, ASCE, Vol. 101, No. HY5, p 449-468, May, 1975. 2 fig, 89 ref.

A Task Committee of the American Society of Civil Engineers has evaluated various aspects of water resources management within the urban environment. Objectives of the study were the preparation of a complete state-of-the-art report on the effects of urbanization on low flow, total runoff, infiltration, and groundwater recharge, a focus on deficiencies in current knowledge with the suggestion of solutions for engineers and researchers, and the dissemination of any findings so that they are readily available to both public officials in urban areas and to urban hydrology specialists. There was found to be a scarcity of data, which was evaluated as highly fractionalized. Data did not directly relate changes in urban development to changes in the hydrologic system. Rather, most former studies were limited to the analysis of the effects of only one component on the hydrologic cycle, such as the effects of low flow or the effects on flood peaks. The majority of these studies were relevant for only a single geographical setting. Figures illustrating a model of the preurban and urban systems demonstrate the substantial increase in complexity with urbanization. Because 70% of the national investment in water resources development has been for urban facilities, a comprehensive and systematic investigation of hydrologic changes in urban areas must be coordinated through efforts on a metropolitan scale, regardless of costs.

*Hydrologic aspects, *Urbanization, *Water resources development, Water management (applied), Runoff, Infiltration, Groundwater, Costs

State-of-the-art reports

H028
LIGHT AND ASSIMILATION NUMBER IN A SMALL DESERT, RECHARGED-GROUNDWATER POND,

Foster, J. M., and Sherwood, B. I.

Arizona State University,
Tempe, Arizona,
Department of Zoology

Oecologia, Vol. 18, No. 2, p 155-194, 1975. 4 fig, 1 tab, 34 ref.

A study was made to evaluate the potential of water reclamation as a solution to water pollution and water storage problems. Physico-chemical and biological studies of recharged-groundwater at the Flushing Meadows Infiltration basins in Phoenix, Arizona, have been carried out, where part of the reclaimed waste water is stored in small artificial ponds. One desert pond (West Pond) was monitored for irradiance, chlorophyll a concentration, respiration, and net and gross photosynthesis. Over a six-month period, chlorophyll a concentration averaged 119 mg/cu m. Gross primary productivity in terms of mean daily carbon fixation rate was 8.29 C/cu m, which is less than many polluted eutrophic lakes and streams and is roughly equivalent to productive fish and farm ponds. A maximum value of gross assimilation number at 0.16 cal/sq cm/min of 30 mg C/hr per ml chlorophyll a indicate that this pond has an excellent photosynthetic capacity.

*Groundwater, *Recharge, *Water reuse, Analytical techniques, Monitoring, Chlorophyll, Photosynthesis, Carbon, Lakes, Eutrophication

Phoenix (Ariz.), Physico-chemical studies, Biological analysis

H029
WATER QUALITY AND SALT WATER INTRUSION IN THE LOWER NECHES RIVER,

Harrel, R. C.

Lamar University
Beaumont, Texas,
Department of Biology

The Texas Journal of Science, Vol. XXVI, No. 1 and 2, p 107-117, February, 1975. 7 fig, 2 tab, 6 ref.

The water of the lower Neches River is used to supply: a large industrial complex consisting of petrochemical refining and manufacturing, and production of lumber products; municipal water for over 350,000 people; and irrigation for 60,000 acres of rice land. The effects of salt water intrusion, carrying with it toxic and organic waste effluents from the industrialized lower reaches, are discussed. The toxic effects are augmented by the erection of salt water dams (to protect the potable water intake points) which cause a concentration of the salt water and effluents. The effects of salt water intrusion on water quality were determined from physico-chemical data and benthic macroinvertebrate studies: dissolved oxygen and pH decreased below the salt water barrier; alkalinity, turbidity, and specific conductance increased below the barrier; the bottom substrate above the barrier was clean fine and coarse sand; below the barrier, the bottom sand was covered with several centimeters of black silt smelling of hydrogen sulfide and oil; density per individual of benthic macroinvertebrates indicated a less stable community structure below the barrier and is indicative of polluted waters; and the particular species collected below the barrier have been previously reported as living in polluted waters while those above the barrier were typically clean water species.

*Water pollution effects, *Saline water intrusion, Saline water barriers, Oil, Municipal wastes, Irrigation, Water quality, Indicators, Benthic fauna, Texas

Neches River, Texas

H030
FLOW QUANTITIES IN RESIDENTIAL WEEPING TILE SYSTEMS--A CALCULATIONAL METHOD,

Zarnett, G. D.

Applied Sciences Section, Pollution Control Branch, Research Paper No. S2042, February, 1975. 28 p, 8 fig, 10 ref.

The installation of weeping tiles for residential property drainage has presented several possibilities of what to do with the collected water including: connection to sanitary sewer; connection to storm sewer; proper grading with runoff away from the house; storage of excess wet weather flow; overflow treatment; and, diversion of roof leader. The proper choice of disposal method depends on the flow quantities per subdivision. A calculational method is presented for determining these quantities based on Darcy's Law and the continuity equation. Requirements for using the calculational procedure are: knowledge of the physiography and soil conditions of the area; proper perspective in the judgement of the hydraulic situation; and, knowledge of the technique used in laying the weeping tile. Parameters involved in the estimation of weeping tile flow quantities are infiltration, the initial process of water seepage through dry or drained soil to reach the water table; weeping tile drainage, the quantity flowing through the drain as a function of the average rainfall intensity; and, time required for drainage after precipitation ceases. A sample calculation of weeping tile flow is presented for a typical house and surrounding property using experimental data obtained from a house in Niagara Falls, Canada.

*Flow measurement, *Tile drains, Urban drainage, Storm water, Storm drains, Storage tanks, Infiltration, Rainfall

Weeping tile drainage

H031
HOW TO EVALUATE WATER MAIN CAPACITIES, PART I,

Curry, M. D., and Wright, R. R.

Water and Sewage Works, Vol. 122, No. 5, p 98-101, May, 1975. 2 fig, 3 tab.

Periodic evaluations of water distribution systems should be performed to protect the monetary investment in constructing this portion of the water supply system. Generalized procedures are available that permit field flow tests and express the system performance in quantitative terms. The importance of the roughness value (C factor) in distribution main analyses is stressed. The C factor is used in the Hazen-Williams formula for hydraulic calculations and represents the resistance to flow or roughness coefficient. Determination of C factors of arterial mains allow the main capacity to be expressed in quantitative terms for comparison with expected performance. The C factor represents quantitatively the head loss in a pipe. Variation in resistance to flow affects the friction loss in a water main and the flow capacity. The C factor is affected by inside pipe diameter and by pipe roughness. Visual observation of sections of a water main may not show the actual roughness present throughout the pipe. Typical C factors for various pipes are given. Four case studies representing C factors determined in the field are presented. Actual values to be expected in any particular community are dependent upon such parameters as the type of water treatment used, control of the treatment processes, soil conditions, and velocities. Measures are mentioned that will aid in the prevention of loss of main capacity.

*Water distribution (applied), *Pipelines, *Roughness coefficient, *Head loss, Hazen-Williams equation, Roughness (hydraulic), Pipe flow, Water conveyance

H032
OPTIMAL RISK-BASED DESIGN OF STORM SEWER NETWORKS,

Tank, H. W., Mays, L. W., and Yen, B. C.

Illinois University,
Urbana,
Department of Civil Engineering.

Journal of the Environmental Engineering Division, ASCE, Vol. 101, No. EE3, p 381-398, June, 1975. 7 fig, 3 tab, 14 ref.

Risks of flooding must be evaluated in various aspects of planning for sewer design. Two storm sewer models of differing complexity were compared, based on cost optimization of expected flood damages. These were then incorporated into a discrete differential dynamic programming (DDDP) solution procedure, in order to optimize the design. The DDDP system was shown to reduce computer time and storage. Expected damage cost was demonstrated numerically to not be a major part of overall expected costs of a sewer system. Thus, a risk-based cost optimization scheme can be successfully applied to storm sewer design utilizing an approximate rather than an exact risk level.

*Storm drains, *Model studies, Flood damage, Computers, Sewerage

Storm sewer design

H033
GROUNDWATER POLLUTION: PROBLEMS AND SOLUTIONS,

Water and Sewage Works, p 125-126, 130-132, 134-136, 138, 140, 142-144, April 30, 1975. 3 fig, 1 tab, 19 ref.

The status of groundwater in the United States is discussed with respect to pollution sources. Potential threats include septic systems, leaching ponds, land application of liquid wastes, groundwater recharge with treated waste waters, sanitary landfills, agricultural use of chemicals, accidental spills of commercial chemicals, and injection wells. Pollutants enter groundwaters by percolation through the unsaturated portion of the earth's crust above the water table or discharge directly into the subsurface water. They are subject to sorption, and to abiotic and biotic chemical alteration. The soil layer of the earth's crust supports intense biological activity. Biochemical alterations occur at this level, and in the subsoil and underlying strata. Microbial activity may occur to a depth of 2000 m below the earth's surface. Groundwater pollutant indicators are total dissolved solids, chlorides, calcium, magnesium, fluorides, sodium, iron, boron, nitrates, phosphates, coliforms, BOD, herbicides, viruses, bacteria, pesticides, acids, arsenic, heavy metals, detergents, phenols, and gasoline. Louisiana is given as a case study of an area with growing problems--salt-water encroachment due to irrigation pumpage, fresh water contamination by salt domes, and locally present iron, fluoride, silica, sulfate, chlorine, methane, hydrogen sulfide gas, and oil field brines. Other case studies include iron and manganese liberation due to infiltrated water from a polluted tributary of the Hudson River in southeastern New York; industrial waste injection in Buffalo, New York; uncontrolled disposal of domestic wastes in Berks County, Pennsylvania; vertical movement of saline water in Baltimore, Maryland; and mineralization in Nevada.

*Water pollution, *Groundwater, Percolation, Wastes, Landfills, Soils, Saline water intrusion, Chemical wastes, Reviews

Chemical spills

H034
ROLE OF COMPUTER SIMULATION IN ADMINISTERING AN URBAN DRAINAGE ORDINANCE,

Debo, T. N., and Lumb, A. M.

Simulation Network Newsletter, Vol. 7, No. 2, p 1-8, February 15, 1975. 6 ref.

A computer-simulated model urban drainage ordinance based on problems, ordinances, and experiences of urban areas was drafted. Emphasis was placed on the interaction between the technical and non-technical aspects of practical drainage problems. Contacts were made with over thirty cities and counties throughout the United States to determine which areas had relevant experience, whether they would participate in the study, and whether they felt they could benefit from results of such a study. Five areas were chosen. The drainage program of each area was intensively investigated and data were compiled into case studies. Some provisions of the model ordinance which was then drafted could pose administrative and engineering problems during implementation, which could be better handled with the help of modelling. Hydrologic computer simulation is a technical tool that may be used with minimal training by engineers of local governments and consulting firms to evaluate the effects of developments, drainage problems, and potential solutions. Once calibrated for a region, a model can be used throughout that area to get a consistent and more accurate approach for evaluating flood and drainage problems. For example, on-site storage facilities are often used in urban areas for controlling storm runoff. However, analysis of their synergistic effects is necessary to prevent potential flood peaks--a problem rapidly solved by computer simulation. Hydrologic simulation results in lower error, greater forecasting capability, enhanced ability to analyze interactive drainage characteristics, and requirements of different areas.

*Computer models, *Legislation, *Drainage, Cities, Floods, Storm runoff, Hydrologic aspects, Administration

Hydrologic simulation

H035
POSSIBILITIES OF WASTE WATER IRRIGATION IN FORESTS
(MOEGLICHKEITEN DER ABWASSERVERREISELUNG IN WALDBESTAENDEN),

Sommer, U., and Fassbender, H. W.

Allgemeine Forstzeitschrift, Vol. 30, No. 22, p 469-471, June, 1975. 5 tab, 3 ref.

Studies of soil chemical composition and hygienic investigations concerning waste water irrigation in forests have been made. Untreated waste water generated in the towns of Wolfsburg and Braunschweig, Germany, is discharged over croplands in summer, and in coniferous forests in winter through percolation by means of movable plastic pipes. Investigations of soil samples from the forests after percolation of waste water revealed a significantly increased phosphorus content, and an increased soil pH due to increased sodium and calcium levels. However, most of the calcium and magnesium inputs are adsorbed by humus. Groundwater samples were seen to contain no pathogenic germs, due to rapid decomposition in the soil. The nitrogen concentrations of the groundwater were below the maximum allowable level. Waste water irrigation caused the positive growth of young trees, and made the species composition of the undergrowth more variegated.

*Irrigation, *Waste disposal, *Soil chemistry, Forests, Crops, Plastic pipes, Phosphorus, Alaklinity, Groundwater, Public health, Soil analysis, Nitrogen, Environmental effects

Germany, Land application

H036
EFFECT OF CESSPOOL DISCHARGE ON GROUND-WATER QUALITY ON LONG ISLAND, N. Y.,

Smith, S. O., and Myott, D. H.

Nassau County Health Department,
Mineola, New York.

Journal of the American Water Works Association, Vol. 67, No. 8, p 456-458, August, 1975. 7 fig, 2 tab.

Groundwater pollution has become a serious threat to the water supply of Nassau County, New York, where 43 percent of the population discharges 60 mgd of sewage into the ground through over 150,000 cesspool systems. The transport of cesspool effluent has caused severe deterioration of water in the uppermost glacial aquifer. This has been accompanied by increased levels of detergent and ammonia. Well and aquifer studies indicated that nitrate nitrogen levels exceeded the drinking water standard of 10 mg/liter and the glacial aquifer was abandoned as a source of potable water. Glacial wells were replaced by deeper wells, but the degradation of deeper areas by nitrates is likely, caused by pumping of deeper wells in addition to natural flow. In the deeper and most important aquifer, the Magothy formation, water with nitrate nitrogen exceeding one mg/liter was found, and nitrate content increases which took place during the past ten years may be a result of sewage discharged as much as 50 years ago. Other constituents derived from cesspools which are increasing include chloride, dissolved solids, hardness, and sulfate. The long range solution undertaken by Nassau County is an extensive sewering project, begun in 1949, which plans for 80 percent of the population to be sewered by 1990. However, construction costs have continued to increase and alternative measures to protect the area's water supply need to be considered.

*Groundwater, *Water supply, *Potable water, *Cesspools, Aquifers, Water pollution effects, Nitrogen, Waste disposal, Sewerage, Planning, Water quality control

H037
RADIOCARBON AGES OF GROUND WATER AS A BASIS FOR THE DETERMINATION OF SAFE LIMITS OF AQUIFER EXPLOITATION,

Tamers, M. A.

Nova University,
Fort Lauderdale, Florida,
Life Sciences Center.

Environmental Research, Vol. 9, No. 3, p 250-264, June, 1975. 4 fig, 2 tab, 18 ref.

The population that can be rationally supported by a municipal aquifer is a function of groundwater renewal rates. Thus, the age of groundwater of the Biscayne aquifer in south Florida was determined using radiocarbon dating techniques. This method provides a safe way to measure the water supply available. Dissolved carbonates were the material for age determination, with limestone dilution corrections of the measured carbon 14 activities made by comparisons of the relative concentrations of bicarbonate and total carbonates. The annual amount of water extracted must not exceed the quantity of rainfall that infiltrates underground in unpolluted zones. It was found for this area that the Hialeah-Preston well fields near Miami are intensively exploited, but produce deep well water free of contamination. The waters presently extracted by the deep wells are below the shallower depths influenced by untreated sewage disposal. For Dade County, and particularly the area around Miami, it was strongly recommended that unless present water treatment methods are improved significantly, the population should not be allowed to double. Deep municipal wells which now extract water are too close to the contaminated zone to permit an increased amount of pumpage without endangering public health.

*Aquifers, *Groundwater, *Water supply, *Potable water, *Radioactive dating, Florida, Water demand, Deep wells, Rainfall

H038
SALT WATER INTRUSION INTO POROUS MEDIA,

Shelat, R. N., Mehta, P. R., and Patel, G. G.

Sardar Vallabhbhai Regional College of Engineering,
Surat, India.

Journal of the Institution of Engineers (India), Vol. 55, Part PH 2, p 55-60, February, 1975. 8 fig, 7 ref.

Experimental model studies were performed to investigate some aspects of subsurface salt water intrusion. The problem of salt water intrusion into coastal aquifers is essentially a problem of stratified fluid flow in porous strata. A boundary surface or interface is formed wherever the two fluids (freshwater and seawater) are in contact. The experimental apparatus comprised a Hele-shaw model, pumping arrangement, and controlling devices. The model consisted of two pieces of 12 mm thick plate glass spaced about 2 mm apart and connected to a reservoir consisting of 20 cm x 20 cm x 70 cm high perspex sheet at either end. A well defined interface between lighter and heavier fluids was shown and the Ghyben-Herzberg relationship was satisfied. A type of mixing distinct from diffusion occurred at the interface whenever the interface shifted. The wedge front velocity was determined to be inversely proportional to wedge length and also dependent upon the inclination of impervious beds and density of the intruding fluid. The fresh water piezometric surface must be above the mean sea level a distance equal to S minus one times the distance below sea level to the lowest pumping zone which must be protected in order to prevent sea water intrusion into coastal aquifer, where S is the specific gravity of sea water. For an aquifer of finite thickness, the maintenance of fresh water surface above sea level will result in seaward loss of fresh water. The relationship between the equilibrium wedge length and the rate of seaward flow of fresh water is independent of the distance of the aquifer below sea level. Correction in overdraft conditions by suitable recharge is a feasible method to check the intrusion.

*Model studies, *Saline water intrusion, Encroachment, Aquifers, Interfaces, Recharge 910

H039
SUMMARY APPRAISALS OF THE NATION'S GROUND-WATER RESOURCES--RIO GRANDE REGION,

West, S. W., and Broadhurst, W. L.

U.S. Geological Survey Professional Paper 813-D, p D1-D39.

As part of a series that will constitute a national compendium on groundwater for planners, this report details the resources of the Rio Grande Region. The knowledge of the resources of the region, as has been described in published reports as well as in unpublished data files of Federal, State, and other agencies, has been combined with statements from many individuals concerned with water problems of the area. The report summarizes this knowledge and evaluates known deficiencies. Primary objectives were to direct attention to the locations and storage capacities of the principal groundwater reservoirs, to delineate the types of information required to better evaluate the opportunities for groundwater management, and to describe how the Rio Grande Region's water needs may be met with groundwater reservoirs. The physical, economic, and legal settings of the Region are detailed, and the groundwater supply is examined in terms of the subregions of the San Luis Valley, the Albuquerque area, the El Paso area, the Pecos Valley, the closed basins area, and the Lower Rio Grande. The withdrawal and consumption of groundwater are considered, and several maps are included. The surface waters of the area are managed by international treaty, interstate compacts, and laws of three separate states; and groundwater management is subject to the differing laws of the states in which the groundwater supplies occur. It was recommended that alternatives in groundwater management allow for: maintenance of full groundwater reservoirs; withdrawal of groundwater from stream-connected aquifers; or withdrawal of groundwater from aquifers isolated from streams. Any large scale development should consider both groundwater and surface waters as being closely related.

*Groundwater, *Surface waters, *Rio Grande River, Water management (applied), Water resources development, Legislation, Federal jurisdiction, State jurisdiction, Regional development, Planning, Water supply, Reservoirs, Aquifers, Economics

H040
CONTROL OF THE POLLUTION OF SURFACE WATER BODIES (BESTRIJDING VERONTREINIGING OPPERVLAKTEWATER),

Wedorp, J. G.

Procestechniek, Vol. 30, No. 14, p 454-456, July, 1975.

The water pollution control program elaborated by the Ministry of Transportation and Water Management and the Ministry of Public Health and Environmental Hygiene of the Netherlands for the 1975 to 1979 period is presented. The waste water treatment capacity is to be increased to 20,000,000 population equivalents by the construction of 118 waste water treatment facilities and by the expansion of 58 existing ones. The percentage of households not connected to sewer systems will be reduced to 8%. Absence of odor, color, and turbidity are the minimum requirements for the water quality to be achieved within the five-year period. Also, any surface water body should be made suitable as a living environment for aerobic organisms, including fish. Water treatment fees to be paid will be determined as a function of transportation distance, capacity of the water treatment facility, soil conditions, and population density.

*Water pollution control, *Public health, *Turbidity, Color, Odor, Surface waters, Aquatic life, Water treatment, Treatment facilities, Waste water treatment, Sewers, Sewerage, Water management (applied)

Netherlands

H041
THE QUALITY AND TREATMENT OF ARTESIAN WATERS IN HUNGARY
(A HAZAI MELYSEGI VIZEK KEZELESENEK SZUKSEGESSEGE ES
TECHNOLOGIAJA),

Kolin, L.

Hidrologiai Kozlony, Vol. 55, No. 6, p 236-244, June, 1975. 8 fig, 2 tab, 4 ref, 8 photo.

The main source of potable water supply in Hungary is artesian waters contained in aquifers 100 to 400 m deep. The water obtained had been of good drinking water quality. Recently, however, dissolved iron and manganese have been detected in amounts exceeding allowable limits. Additionally, considerable amounts of gas containing methane have appeared in these artesian waters. Therefore, prior to introduction into the distribution network, the artesian waters must be appropriately treated by iron and manganese removal as well as by de-gassing. Iron and manganese are removed by a conventional technique, involving oxidation with air under pressure, followed by filtration on two-layer sand filters. Surface aeration by means of revolving brushes has been applied for de-gassing, and tests are under way on a more simplified and economical new method.

*Water treatment, *Potable water, *Water supply, *Acquifers, Iron, Methane, Manganese, Filtration, Artesian wells

Hungary, Melyepterv

H042
LONG- AND SHORT-TERM FORECASTING OF RIVER DISCHARGE,

Hino, M., and Ishikawa, K.

Domiku Gakkai Ronbun Hokokushu, No. 236, p 59-70, April, 1975. 15 fig, 4 tab, 9 ref.

Analysis of river discharge variation was carried out for the Sagami River, Japan, by canonical factor analysis. Prediction of long-term river discharge was performed by a reconstruction of several factors. Inflow data at Sagami Dam obtained from 1953 to 1970 showed a constant flow rate of approximately 30 cu m/sec from January to April, and great variation for the periods from the end of June to the beginning of July, mid-August to the end of August, and from mid-September to the end of that month. Drought had a periodicity of three years while severe drought had a periodicity of six years. Flood occurred from the end of June to the beginning of July due to concentrated rain; from mid-August to the end of August due to summer typhoon; and from the end of September to the beginning of October due to fall typhoon. The factors considered included basic analysis independent of the effects of rain and typhoon, seasonal variations, and rain and typhoon factors.

*Forecasting, *Rivers, Inflow, Data collection, Flow rate, Flood forecasting, Floods, Rain, Precipitation (atmospheric), Mathematical studies, Hydrological aspects

River discharge, Factor analysis, Japan, Typhoon

H043
THE SIGNIFICANCE OF HYDROGEN SULFIDE IN GROUNDWATER,

Li, E. C. C.

Water and Sewage Works, Vol. 122, No. 8, p 66-67, August, 1975. 3 tab, 8 ref.

Hydrogen sulfide is found in groundwater mainly as a result of anaerobic sulfate reductions. An analysis was made of the concentrations of sulfide in groundwater. Three drilled wells in Oklahoma were sampled; these were located within a sanitary landfill, 0.7 miles upstream from the landfill site, and one mile downstream from the site. Water and mud were collected and analyzed for chemical parameters and for the presence of sulfate-reducing bacteria. It was found that landfill groundwater and downstream groundwater were in reducing states with an anaerobic environment; upstream groundwater was also in a reducing state and had a microaerophilic environment. A relatively high concentration of dissolved sulfate was found in the landfill groundwater, indicating that decomposed products containing large quantities of sulfate in the landfill were leaching into the groundwater. Analysis of bottom muds showed that sulfide sulfur was dominant, particularly in the landfill sample and was associated with dissimilatory sulfate reducing bacteria that exist only under strict anaerobic conditions. Since organic matter stagnated and accumulated in the landfill area, most sulfate reduction occurred near the mud surface, causing serious pollution at that location.

*Anaerobic conditions, *Anaerobic bacteria, *Groundwater, *Analytical techniques, *Hydrogen sulfide, Sulfides, Sulfates, Groundwater resources, Leaching, Water pollution sources, Water quality

Landfills, Groundwater quality

H044
WATER QUALITY CHANGES RELATED TO THE DEVELOPMENT OF ANAEROBIC CONDITIONS DURING ARTIFICIAL RECHARGE,

Wood, W. W., and Bassett, R. L.

U. S. Geological Survey,
Lubbock, Texas.

Water Resources Research, Vol. 11, No. 4, p 553-558, August, 1975. 6 fig, 3 tab, 15 ref.

An artificial recharge experiment was conducted in a spreading basin at Lubbock, Texas, and illustrated that a significant change in the chemical quality of recharged water was associated with the growth of anaerobic bacteria. The growth of significant quantities of anaerobic bacteria in an artificial recharge site is generally dependent upon the quantity of utilizable organic material and the absence of oxygen; necessary trace metals and environmental conditions needed to support a bacterial community were assumed to be present in the soil. It was concluded that in this case, soluble and particulate organic matter were retained near the sediment-water interface and subjected to actions of the microbial populations there. Because oxygen was still available near the top of the soil column, biodegradable organic compounds were mineralized to simple inorganic compounds. When the recharged water contains more biodegradable organic material than could be consumed by the aerobic bacteria, the zone of adsorbed organic material increased with depth below the interface of the water and sediment. The depth to which dissolved oxygen could penetrate decreased with time because the accumulating organic carbon supply resulted in increased organic growth. Thus, the increased depth of penetration of the organic material, coupled with a reduction in depth of oxygen penetration, allowed the system to become anaerobic in the presence of a large amount of biodegradable material. Once the hydraulic conductivity was lost, the upward migration of the anaerobic zone accelerated. By measuring the concentrations of bicarbonate in the recharged water at several shallow depths, the growth and development of sulfate-reducing bacteria was monitored and thus the oxidation state of the aquifer was determined.

*Aquifers, *Anaerobic conditions, *Water quality control, Oxygen, Monitoring,

*Recharge, *Groundwater, *Recycling, Water supply, [illegible]
wells, Municipal wastes, Water reuse

H045
PRIVATE CONSTRAINTS ON GROUND-WATER CONTAMINATION,

Walker, W. R., and Cox, W. E.

Virginia Polytechnic Institute and State University,
Blacksburg,
Virginia Water Resources Research Center.

Journal of the Hydraulics Division-ASCE, Vol. 101, No. HY10, p 1333-1341, October, 1975. 29 refs.

While water rights have been supplemented by direct governmental controls in the case of surface waters, protection of groundwater quality has been inadequate. Various judicial decisions regarding the rights of a groundwater user to an uncontaminated water supply are presented. The interpretations of court cases showed no clear patterns of legal action. In many cases, potential sources of groundwater pollution are essentially unregulated, and in cases where penalties for groundwater contamination do exist, there is no means for assuring recovery of losses. A 1970 survey indicated that groundwater constituted about one-third of public water supplies and provided about 95% of water used by 41 million people served by private domestic systems in the United States. It was strongly recommended that more comprehensive and effective controls are needed to supplement the mechanism of water rights and to protect the domestic water supplies.

*Groundwater, *Water rights, *Water quality control, *Water pollution control, Hydrologic aspects, Legal aspects, Water pollution sources, Water supply

*Groundwater pollution

H046
ARTIFICIAL GROUNDWATER RECHARGE AND WASTEWATER RECLAMATION,

Baffa, J. J.

Suffolk County Department of Health,
Suffolk, New York.

American Water Works Association Journal, Vol. 67, No. 9, p 471-476, September, 1975. 8 fig, 5 ref.

Economic, conservation, and research factors pertinent to artificial groundwater recharge and waste water reclamation were discussed. Artificial recharge of aquifers has been used successfully for groundwater management in preventing losses to stream flow. Research has been conducted on hydraulic aspects, particularly on how to most efficiently use the soil and recharge water interface to allow maximum rates of transfer of recharge water to the aquifer. The capability of these systems to remove nitrogen from waste waters has been of considerable interest. A pilot plant shallow well injection system was tested. Effluent from a municipal single-stage trickling filter plant was injected through wells, which were then used for water quality sampling. After a three-year period, water quality parameters were separated into two categories: those of a soluble stable mineral character such as chlorides and alkalinity; and those with latent biological propensities such as nitrogen compounds, sulfates, phosphates, carbon dioxide, and organic solids. Concentrations found were affected by the amount of water recharged, the amount of natural groundwater flow (which causes dilution), changes in aquifer permeability from clogging, and biochemical effects of bacterial action. It was concluded that for all water quality parameters, adsorption and dilution were important factors. To reduce soil clogging and to prevent release of unwanted nitrogenous compounds, it was suggested that organics and nutrients be removed by tertiary treatment, particularly when the objective of artificial recharge is municipal water supply.

*Recharge, *Groundwater, *Recycling, Water supply, Conservation, Economics, Injection wells, Municipal wastes, Water reuse

H047
ENVIRONMENTAL CLEANUP 1975-1985: HUGE NEW COSTS, LITTLE BENEFIT,

Olds, F. C.

Power Engineering, Vol. 79, No. 9, p 38-45, September, 1975. 2 fig, 4 tab.

An overview of the costs of environmental cleanup for the past five years and for the next decade is presented. Major federal regulations for both air and water pollution control are summarized. Published figures from agencies showed cleanup costs to be $300 billion. This did not include the $15 to $20 billion of capital to build power plants each year due to environmentally related stretch-outs in schedules or the $4 to $5 billion annually spent to purchase oil to substitute for unfinished nuclear plants. The costs also failed to include those of acid mine drainage, agricultural feed lot runoff, urban storm water runoff problems, zero discharge, and other hydrological and environmental problems. Present laws have proved unworkable and unrealistic. Proposed costs to meet the "best available technology" standard set forth for 1983 were estimated at $220 billion for 1972 to 1983. If zero discharge is enforced, the impact on land and aquifers from the impoundment of water containing BOD, chemicals and fine solids may be serious. Other costs related to the enforcement of environmental regulations are less direct, such as the cost to industry of pollution abatement, which will be passed on to the consumer in the form of higher prices for various products.

*Environmental effects, *Water quality control, Water pollution control, Pollution abatement, Legislation, Federal Water Pollution Control Act, Federal jurisdiction, Costs, Economics

Zero pollution discharge

H048
OPTIMAL POLLUTION CONTROL WITH A NONCONSTANT EXPONENTIAL RATE OF DECAY,

Forster, B. A.

Guelph University,
Ontario, Canada,
Department of Economics.

Journal of Environmental Economics and Management, Vol. 2, No. 1, p 1-6, September, 1975. 3 fig, 10 ref.

While most recent pollution control studies have assumed a constant exponential decay rate, this paper examines the effects of introducing a nonconstant exponential decay rate into a pollution control model. The question posed to the economist was whether it is ever optimal to let a waterway such as Lake Erie die. If the pollution level becomes great enough, a waterway may be unable to cleanse itself. A model was formulated, allowing for the fact that pollution may depress the rate of self-purification of a body of water. A previously defined decay function was used to outline a descriptive theory of pollution and capital accumulation. The analysis suggested that the choice of cleaning up overly polluted lakes is dependent upon the social welfare objectives and priorities of the particular society.

*Water pollution control, Hydrologic aspects, Lakes, Mathematical models, Economics, Model studies, Planning, Water management (applied), Water resources development

H049
WATER MANAGEMENT IN ENGLAND: A REGIONAL MODEL,

Okun, D. A.

North Carolina University,
Chapel Hill,
Department of Environmental Sciences and Engineering.

Environmental Science and Technology, Vol. 9, No. 10, p 918-923, October, 1975.
1 tab.

The reorganization of water management in England, with its flexibility and cost-effectiveness, is contrasted with the situation in the United States. A history of water management developments in England over the past thirty years is presented. The key agencies of the 1973 Water Act reorganization are the 10 Regional Water Authorities (RWAs). These are based on hydrologic boundaries and optimize systems for all the communities they serve. Responsibilities of RWA headquarters include financing, planning, and water quality monitoring. Each of 152 multifunctional (water supply/rivers/waste water disposal) divisions within the RWAs is responsible for customer services, facilities operation, and design and construction of new facilities. In the United States, where each local authority is responsible for effluent discharges, the regulatory approach is a uniform effluent standard. This policy seems fair but is often uneconomical. In England, where there is single ownership of all treatment facilities on a given river, an optimization model can indicate a least-cost solution for the entire region. Financing of water pollution control in the United States under the construction grants program (where construction costs are met by federal funds while operation and maintenance costs are met locally) has caused trends towards excessive construction and poor operation. In Great Britain, each water authority determines the construction for that region, (based on financial resources and need), optimizes total costs, and raise all its own funds.

*Administration, *Water management (applied), *Economics, Regional development, Rivers, Waste water treatment, Water supply, Effluents, Treatment facilities, Financing

Regional Water Authorities (Great Britain)

H050
NITRATES IN WISCONSIN GROUND WATER,

Schuknecht, B., Lawton, G. W., Steinke, P., and Delfino, J. J.

Wisconsin University, Madison,
State Laboratory of Hygiene.

Environmental Letters, Vol. 9, No. 1, p 91-98, 1975. 15 ref.

Nitrates in groundwater are sometimes found in unacceptably high levels. In earlier studies they were found to be reduced by bacteria in infants' digestive tracts to nitrites and cause methemoglobinemia. Nitrate analyses were performed on groundwater well samples originating from sources throughout Wisconsin. Wells of varying types, age and quality of construction were included in the test. The phenoldisulfonic acid method and an automated diazotization technique were used to determine the nitrate concentrations. Both techniques yielded comparable data. Results of the testing program showed that 38% and 39% of all wells in Columbia and Dane counties, respectively, had nitrate levels above the drinking water standard of 10 mg NO3-N/liter. Most of the deeper wells had lower nitrate levels than shallow wells. In Columbia county nitrate levels were influenced by the relative proximity of the well to barnyards, sewage seepage areas, animal feedlots and liquid manure storage facilities. About 9% of samples selected randomly across the state had nitrate levels above 10 mg NO3-N/liter, and six counties had 20% of the wells over the standard. Newer wells had considerably lower nitrate levels than older wells, mainly due to the greater depth of the newer wells, and improved drilling and construction standards.

*Nitrates, *Groundwater, *Wisconsin, Wells, Chemical analysis, Pollutant identification, Sewage, Potable water, Bacteria, Nitrites, Public health

Methemoglobinemia, Columbia county (Wisc), Dane county (Wisc), Phenoldisulfonic acid method, Automated diazotization technique

H051
GROUNDWATER POLLUTION CONTROL IN AN INDUSTRIALIZED PART OF THE TRENT BASIN,

Dowse, L. H., and Selby, K. H.

Water Pollution Control, Vol. 74, No. 5, p 526-541, 1975. 6 fig, 6 tab, 17 ref.

Although greater than 35% of the public water supplies in the United Kingdom are abstracted from groundwater sources, the groundwater quality control aspects of the river authorities' functions have received little attention. Groundwater pollution control in an industrialized part of the Trent area is discussed. The geology and hydrogeology of the area are outlined. Groundwater is considered in terms of chemistry, relationship with surface water, and resources. The migration and persistence of pollutants in groundwater are controlled by factors falling into three groups: hydrogeological, physico-chemical, and biological. Groundwater pollution sources include agricultural practices, direct discharges of industrial or municipal waste water, accidental discharges, overflowing cesspools and septic tanks, disposal of wastes including domestic and industrial refuse and sewage sludges, and natural sources. The presently fragmented and incomplete legal controls of groundwater pollution will be strengthened by additional powers incorporated in the Control of Pollution Act 1974. Two types of surveillance systems are being used by the Trent Authority. Aquifer protection includes waste disposal site selection, classification of wastes and existing disposal sites, site preparation and remedial works, and pretreatment such as chemical fixation methods. Case histories are presented on: pollution from an industrial waste tip; pollution by direct discharge; pollution of River Tame from galvanizing works; pollution due to accidental leakage of oil; and, contamination due to an unknown (possibly natural) source.

*Groundwater, *Water pollution sources, Water pollution control, Administration, Legislation, Hydrogeology, Water supplies, Monitoring, Aquifers, Waste disposal

Groundwater pollution control

H052
UNSATURATED FLOW DURING SOIL TREATMENT OF SEPTIC TANK EFFLUENT,

Bouma, J.

Soil Survey Institute, Wageningen, The Netherlands.

Journal of the Environmental Engineering Division-ASCE, Vol. 101, No. EE6, p 967-983, December, 1975. 2 fig, 2 tab, 41 ref, 2 append.

The physical theory of unsaturated flow associated with liquid movement through barriers is examined and some practical implications are studied. Tensiometric in-situ measurements made in soil surrounding operating seepage systems in a wide range of soils are presented and examined. Implications following from the availability of such data for design procedures of waste disposal systems are examined. Subsurface soil disposal of household liquid wastes involves processes of unsaturated flow and the potential of different soils for on-site disposal, and can be described only if hydraulic head curves are available. The effects of soil clogging or soil compaction on infiltration into seepage are a function of the barrier resistance and capillary properties of the soil. To adequately purify septic tank effluent, unsaturated flow is necessary. Data indicate that three feet of soil are required to achieve pathogenic purification, providing the soil is not overloaded. The effluent must be evenly distributed over the seepage area during each application to achieve adequate purification in unclogged sands, and to avoid clogging in weak loamy soils. Construction of shallow trench seepage systems in clayey soil is recommended to avoid compaction and puddling of infiltrative surfaces. Large undisturbed soil columns must be used for laboratory studies to be useful. Columns of improper length filled with sieved aggregates have different hydraulic characteristics. Elaborate on-site testing can be reduced by using classification schemes and soil maps.

*Soil treatment, *Septic tanks, *Effluents, On-site tests, Pathogenic bacteria, Hydraulic conductivity, Hydraulic gradient, Hydraulics, Flow, Waste water

H053
A SUMMARY OF THE BIOGEOCHEMISTRY OF NITROGEN COMPOUNDS IN GROUND WATER,

Behnke, J.

Journal of Hydrology, Vol. 27, p 155-167, 1975. 4 fig, 1 tab, 55 ref.

The biogeochemistry of nitrogen compounds in ground water is complex and poorly understood. In natural waters, nitrogen compounds generally occur in three ionic forms: ammonium, nitrite, and nitrate. Microorganisms transform atmospheric nitrogen into fixed forms such as ammonium and nitrate. Other microorganisms denitrify nitrogen back into gaseous forms such as nitrous oxide and free nitrogen. Nitrates represent the end products of the biological nitrification process and are monitored as the primary pollution parameter. High nitrate concentrations in drinking water create a human health hazard, nitrate cyanosis. This disease is caused by the bacterial reduction of nitrate to nitrite in the intestinal tract. The nitrite then enters the blood-stream and combines with the hemoglobin to form methomoglobin, which reduces the blood's capacity to transport oxygen. Nearly all cases of excessive nitrate build-ups in shallow ground waters appear to be related to the downward leaching of nitrogen by surface water. Reported sources for ground water nitrate contamination include decaying plant and animal material, organic sediments, agricultural fertilizers, domestic sewage, and areas of high density animal confinement.

*Groundwater, *Nitrates, *Nitrogen, Monitoring, Data collection, Aquifers, Sewage effluents, Water pollution, Geochemistry, Biochemistry, Pollutant identification, Hydrology

H054
PROTECTING GROUNDWATER FROM LANDFILL LEACHATE,

Walls, J. S., and Cummings, R. E.

Lycoming County Planning Commission,
Williamsport, Pennsylvania.

Water and Sewage Works, Vol. 122, No. 12, p 68-69, December, 1975. 2 fig.

Several new elements to protect groundwater from leachate contamination have been designed for a sanitary landfill in Lycoming County, Pennsylvania. Because the BOD content of leachate is a danger to public health, the planners intend to collect the leachate and treat it biologically and chemically before recirculating it. The main feature of the design is a continuous multi-layer barrier separating the undisturbed existing earth from the landfill. From bottom to top, the barrier consists of a layer of sand, a 20-mil thick sheet of impermeable PVC, another layer of sand, and a layer of clayey soil. Sets of horizontal drainpipes above the plastic barrier will carry leachate away for treatment and recirculation. Laboratory tests have shown that the leachate strength can be lowered to acceptable levels through use of aeration to provide aerobic stabilization. The Lycoming system will consists of a 10 ft deep million gallon capacity lagoon with seven days retention time. Two 7 1/2 hp vertical aerators will initially furnish the necessary oxygen. The landfill should solve the solid waste disposal problems of a group of adjoining semi-rural counties. The initial rate of waste to be handled by the fill is estimated at up to 400 tons per day.

*Groundwater, *Waste disposal, *Public health, *Leachate, Landfills, Lagoons, Laboratory tests, Environmental effects

Sanitary landfills, Land application

H055
CLASSIFICATION OF METHODS OF GROUNDWATER MANAGEMENT
(Klassificaksiiya metodov upravleniya rezhimom i resursami podzemnykh vod),

Akhmedsafin, U. M., and Shestakov, F. V.

Vestnik Akademii Nauk Kazakhskoy SSR, No. 7, p 3-13, 1975. 3 tab, 17 ref.

Classification is presented of different methods of groundwater management. Forced or siphon type groundwater capture is widely used for water supply, while the use of explosive or nuclear energy to increase the hydrostatic pressure is in an experimental stage. Artificial recharge is used commonly for water supply in areas with limited water resources. The water table is lowered for ameliorative purpose, to make the extraction of minerals possible, or to prevent the intrusion of sea-water. Groumd-water can be displaced to more favorable sites by pressure in air or gases.

*Groundwater, *Water management (applied), Siphons, Water supply, Recharge, Water table, Pressure, Water resources development, Hydrology

Groundwater management

H056
HYDROLOGICAL AND HYDROGEOLOGICAL ASSESSMENT OF LANDFILL SITES,

Aspinwall, R.

Solid Wastes, Vol. 65, No. 8, p 390-403, August, 1975.

The variables of a solid waste disposal pit are the amount of rainfall, the overall catchment area of the pit, the actual top of the excavation, the volume of waste going into the pit, and the catchment area which must be controlled by artificial drainage works. If a pit is lined with impervious clay, the leachates will not seep away and the pit will fill up with water not only from rainfall but also from liquid wastes that have no other disposal system available. In England it was estimated that there are some 500 million gallons of liquid waste produced annually that are unacceptable for incineration or mineshaft disposal and are probably being dumped anywhere space can be found. For pit disposal in the present clay lined type, a conservative estimate of 30-acre pits needed for waste disposal would be 12 new pits a year. In addition, this solution of waste disposal produces water pollution and health hazards. A new model of landfill site has been proposed: a permeable earth medium on top of a permanent saturation. The chemical properties of the earth, especially with some clay present, would remove heavy metals and degrade the leachate. At the saturate zone the leachate would be diluted with existing groundwater and travel a long distance to a safe discharge point in the sea or a river. Such a site would be considered an aquifer and an important national asset as a water storage and collection site. Local water authorities might object to the idea, but the need for safe waste disposal must be weighed against the loss of some aquifers.

*Solid wastes, *Landfill, *Waste disposal, Rainfall, Drainage, Public health, Soil chemical properties, Soil physical properties, Aquifers, Environmental effects, Aquifers

H057
DISTRIBUTION FUNCTIONS LIMITED AT THE ORIGIN (IM URSPRUNG BEGRENZTE VERTEILUNGSFUNKTIONEN),

Mueller, P-H., Traus, W., and Vahl, H.

Wasserwirtschaft, Vol. 65, No. 11, p 296-301, 1975. 2 fig, 7 tab, 14 ref.

In order to better adapt a hydrological time-series to the actual physical conditions, it is desirable to transform left limited distribution functions in such a way that they begin in the origin. A method for performing this transformation was applied to the Pearson-Type-3-Distribution and to the Extremal-Type-3-Distribution. The k-values of the distribution functions gained in this way have been computed. For the simple application of the chi squared test, the tables for the standardized density functions have also been added.

*Statistical methods, *Mathematical studies, *Hydrology, Time series analysis, Synthetic hydrology

*Hydrological time series

J001
NEEDED: $350 BILLION - AND A NEW NEEDS SURVEY,

Heid, A. S.

Journal of the Water Pollution Control Federation, Vol. 46, No. 10, p 2254-2257, October, 1974. 1 tab.

State agencies have now estimated that to meet the 1983 goals of the Federal Water Pollution Control Act Amendments of 1972, they would require $350 billion. Money needed for treatment and control of storm water, a category not previously included, totals $235 billion. Omitting this category, the states' estimated needs for 1974 are $55 billion more than the $60 billion in reported needs in the 1973 survey. The 1974 needs survey was ordered by Congress to provide information on states' estimated needs to form a basis for the consideration of a new authorization for granting construction funds and for future allocations to the states. The cost estimates of the 1973 survey represented only a first step in the necessary assessment of construction costs; however, as reported by R. Train, EPA administrator, the EPA preliminary analysis exaggerates the costs of meeting the requirements of PL 92-500, and that there are less expensive methods of abating storm water pollution than those figured in the costs. In addition, the EPA considers the important areas for granting construction funds as the following categories: Category I which covers the costs necessary to achieve the required level of secondary treatment; Category II which includes the costs necessary to achieve more stringent levels of treatment than secondary treatment for cases in which advanced treatment is implicit for meeting established standards for water quality; and, Category IVb which represents the costs of needs for new interceptor sewers.

*Federal Water Pollution Control Act, *Water pollution control, *Pollution abatement, *Costs, *Construction, Facilities, Storm water, Sewage treatment, Tertiary treatment, Sewers, Governments, Legislation, Governments supports, Financing

J002
LET'S TRY 90% FIRST AND SEE WHAT OUR QUALITY IS LIKE,

Masselli, J. W., Masselli, N. W., and Burford, M. G.

Wesleyan University, Middletown, Connecticut , Industrial Waste Laboratory

Textile Industries, Vol. 138, No. 10, p 32-33, 35, 145, October, 1974. 1 tab. 4 ref.

The problems and increased cost of analytical testing and pollution abatement associated with the Effluent Guidelines and Standards, published by the Environmental Protection Agency on July 5, 1974, are discussed. The BOD requirements are considered too stringent and impractical and unattainable except at great cost. COD should not be listed as a required parameter because the mercury and silver used in the analysis may cause more harm to the ecology and economy than the large volume of organic wastes being investigated. Phenol should not have been considered a separate parameter because it is rapidly oxidized and completely removed in the activated sludge process. For the same reason, sulfide should not be listed as a separate parameter. The APHA color determination is difficult and confusing. The authors feel that color determinations or color removal should not be required except when the color of the receiving stream is significantly altered visually. This listing of many parameters results in increased costs. The ruling that COD, phenol, sulfide, and oil and grease are incompatible water pollutants which will interfere with the operation of municipal treatment plants is considered to be incorrect since these substances are now being treated in activated sludge plants without lowering efficiency. Following this regulation means that essentially double treatment will occur as the plants must pretreat their wastes before joint treatment is allowed. The neutralization of an alkaline pH is also shown to be unnecessary and even disadvantageous.

*Pollution abatement, *Standards, *Legislation, *Water quality control, Regulation, Pre-treatment, Biochemical Oxygen demand, Chemical oxygen demand, Phenol, Sulfide, Color, Industrial wastes

J003
REGIONAL AUTHORITIES TAKE OVER BRITAIN'S WATER/SEWAGE SYSTEMS,

Ardill, J.

"The Guardian", London, England

Water and Sewage Works, Vol. 121, No. 68, p 72-73, August, 1974. 1 fig.

On April 1, 1974, some 1600 water supply, river management, sewerage and other water agencies of England and Wales were taken over by ten Water Authorities (WAs). This fundamental changeover was accomplished within nine months from the passage of the legislation. Apart from the three posts of chief executive and directors of finance and operations in each region, all other situations were filled from among those already employed in the industry or local government. The Yorkshire Water Authority in northern England has been able to solidify into the form of organization that is the goal of the reorganization; the concentration of all the diverse activities of the industry into a small number of territorial operating divisions with a single line of management from the divisional director to the regional director of operations. The philosophy of the Yorkshire WA is that the key to the integration of all the WAs' responsibilities, such as the conservation and supply of water, removal and treatment of sewage, drainage and flood protection and the protection and enhancement of the amenity and recreational aspects of water space, is the river itself. Rather than the traditional situation in the local authorities and river authorities, where management has been organized by professional hierarchies, the WAs are organizing on interdisciplinary lines to form a system of management integration. In the long run it is expected that the regional system will produce savings in administrative manpower, payroll, and elimination of unnecessary duplication in capital works.

*Management, *Legislation, *Water management (applied), Water supply development, Sewage treatment, Water utilization, Reservoir operation, Government

*Water Authorities, England, Wales

J004
LEGISLATIVE HISTORY OF THE SAFE DRINKING WATER ACT,

Kyros, P. N.

US Representative, First District, Maine

American Water Works Association Journal, Vol. 66, No. 10, p 566-569, October, 1974. 4 fig.

A brief history of the Safe Drinking Water Act, the need for such legislation, some of the legislative obstacles encountered, and the major provisions of the final bill are discussed. Federal legislation concerning the safety of drinking water has been in the House since 1970. The need for such a bill was highlighted by many newspaper reports issuing statements of concern over the quality of water and a HEW study conducted in 1969 and 1970 which concluded that approximately 5.4% of all US citizens were being served substandard water from approximately 5000 of the nation's community water systems. Federal standards have been in effect since 1914 concerning the quality of potable water provided on interstate carriers and standards are now necessary to cover all aspects of water quality. Obstacles encountered included objections toward letting the EPA administer such a project, loss of interest after the Water Pollution Control Act of 1972 was passed, and the difficulty in knowing exactly what to legislate for or against. The Safe Drinking Water Act provides for the control of underground-injection programs to protect against endangering drinking water sources. Under this bill, the states will have the primary enforcement responsibility to monitor and inspect community water systems to assure their compliance with federal standards; the states will also have the power to grant variances to systems because of the characteristics of the raw-water source or because a required treatment technique is not necessary. Federal funds for research and demonstration projects also part of the bill.

*Public health, *Potable water, *Water supply, *Standards, Legislation, Regulation, Water quality control, Water purification

*Safe Drinking Water Act

J005
AMENDMENTS TO THE WATER ACT,

O'Brien, B.

Mining Congress Journal, Vol. 60, No. 8, p 54, August, 1974.

A recommendation by the Environmental Protection Agency to Congress for amendments to the Water Act is in the near future. An extension to three years for compliance with the toxic water pollution limitations will be requested. It is expected that the EPA will also ask for a transformation of the present formal hearings on proposed toxic regulations into informal proceedings. Russell Train, EPA Administrator, states that his organization is considering asking for authority to grant exceptions from the toxic limitations for a plant which is unable to meet the requirements due to no available technology for the treatment of the particular waste. The amendments should be submitted by the EPA to Congress in January of 1975.

*Toxicity, *Water pollution, Water law, Federal government, Regulation, Standards, Control

*Environmental Protection Agency, *House Public Works Subcommittee on Investigations and Review, The Water Act

J006
SENSITIVITY OF HUMAN DIPLOID EMBRYONIC LUNG CELLS FROM ISOLATION OF ECHO VIRUSES FROM SEWAGE,

Zdrazilek, J.

Institute of Hygiene and Epidemiology, Prague, Czechoslavakia

Journal of Hygiene, Epidemiology, Microbiology and Immunology, Vol. 18, No. 1, p 2-8, 1974. 3 tab, 8 ref.

Enteroviruses from Prague, Czechoslavia, sewage samples were isolated on a strain of human diploid embryonic lung cells (HDLC) and on secondary monkey kidney cell cultures (MKC). The sewage samples were obtained from ten Prague nursery schools and two main sewers of the city. Thirty-six poliovirus strains of each of the three types and 47 ECHO virus strains were isolated. Twenty-four of the poliovirus strains had a cytopathic effect on the MKC cultures only, while 31 ECHO virus strains had a cytopathic effect on HDLC cultures, and 12 others produced a cytopathic effect on both kinds of cells. The parallel titration of the ECHO virus strains isolated on HDLC and MKC determined that most of the strains, on the type of cells on which the virus strains were found, produced a cytopathic effect in a dilution greater than others by one or more log. The possibility that a greater resistance of HDLC to the non-viral toxicity of some sewage samples influenced the success of the isolation of enteroviruses was considered.

*Sewage, *Viruses, *Epidemiology, *Public health, *Pollutant identification, *Water pollution sources, Diseases, Cytological studies, Water pollution, Foreign research

*Enteroviruses, Prague (Czech)

J007
ARSENIC IN SEDIMENTS ON THE CONTINENTAL SHELF OF SOUTHEAST AUSTRALIA,

Davies, P. J.

Bureau of Mineral Resources, Geology and Geophysics, Canberra, Australia

Search, Vol. 5, No. 8, p 394-396, August, 1974. 1 fig, 2 tab.

The presence of arsenic in the shelf sediments of southeast Australia was discovered as a result of a reconnaissance geological survey conducted by the Bureau of Mineral Resources during 1972. The arsenic contents in the shelf sediments were found to be up to two orders of magnitude higher than those reported for average shale, sandstone, and limestone. The maximum arsenic concentrations occur offshore from areas of major urban and industrial development, and not offshore from agricultural areas. Support for the suggestion that the arsenic is deposited as the result of urban pollution comes from another study showing the increasing concentrations of arsenic in the Kansas River due to pollution by detergents used in household washing. It was concluded that arsenic is enriched in the surface sediments of the continental shelf of southeast Australia, particularly between Port Kembla and Newcastle, where concentrations of 50-100 ppm are common. The arsenic may be derived from the natural erosion of rock, or from urban and industrial effluents. The complexing of arsenic with colloidal manganese compounds results in its deposition in the quieter areas of the middle to outer shelf. A series of sediment cores drilled in the areas of high arsenic concentrations could be analysed to determine whether the high arsenic values are due to modern urban/industrial effluents, or related to natural concentration mechanisms coupled with non-sedimentation.

*Arsenic compounds, *Sediment distribution, *Municipal wastes, *Industrial wastes, Sediments, Sedimentology, Sediment-water interfaces, Agricultural runoff, Agricultural chemicals, Water pollution sources, Effluents

J008
FEDERAL ASSISTANCE PROGRAMS FOR WATER POLLUTION CONTROL TECHNOLOGY DEVELOPMENT,

Hurtubise, F. G., and Townshend, A. R.

Technology Development Branch, Water Pollution Control Directorate, Environment Canada

1974 Annual Conference Pollution Control Association of Ontario, May 1-3, 1974. 30 p, 10 tab.

The municipalities and industries of Canada must now improve their methods of waste water treatment to control or prevent pollution of the Canadian waterways. The Canadian Federal government has many assistance programs to encourage universities, research centers, consultants, industries and municipalities to carry out research and development on improved waste water treatment processes. The various programs offered are examined. The programs include: the Cooperative Pollution Abatement Research program for the pulp and paper industry, the Water Resources Research Support Program for the universities, and the undertaking of cost-shared programs with the industrial sector for the development and demonstration of new water pollution abatement technology, all administered by Environment Canada; the Industrial Research and Development Incentive Act program and the Program for the Advancement of Industrial Technology, both administered by the Department of Industry, Trade and Commerce; the Industrial Research Assistance Program of the National Research Council; and the research and developmental program under Part V of the National Housing Act administered by Central Mortgage and Housing Corporation. The role of the Science Procurement Sector in coordinating unsolicited R and D proposals and in obtaining contract R and D work for Government departments and agencies is explained. The assistance programs of the Central Mortgage and Housing Corporation and Environment Canada for the construction of water pollution control facilities are presented.

*Waste water treatment, *Research and development, *Government support

J009
LACK OF PROMISED FEDERAL FUNDS HAMPERS WATER CLEANUP EFFORT,

Engineering News-Record, Vol. 193, No. 15, p 24-25, October, 1974.

Cities in the U.S. are faced with the problem of how to meet the regulations of the 1972 Federal Water Pollution Control Act. Difficulties in obtaining equipment, material shortages, rapidly escalating prices and the lack of promised federal funds all place limits on cities' ability to spend money effectively. The federal government is to provide 75% of the cost of municipal treatment works; this limits the number of projects that can be funded because of the limited amount of money available. The 1974 survey of needs for municipal waste water treatment works released in September 1974, lists a total of $114 billion needed to meet 1983 clean water standards (excluding storm water treatment and/or control). The EPA expects to allocate only $3.5 billion for this fiscal year 1975. There is a debate between the federal government and cities and states over the cost of controlling the pollution caused by storm water runoff. Chicago, San Francisco, Atlanta and Boston report multi-million dollar needs for pollution control facilities for storm water treatment. They plan to build deep tunnel systems, catchment basins, or other storm water control works. However, most of these storm water plans rate so low on the EPA priority list that they don't receive any federal funds. The agency will not fund storm water facilities until state and local agency show that they are necessary to meet 1977 standards.

*Waste water treatment, *Facilities, *Legislation, *Federal Water Pollution Control Act, Costs, Financing, Storm runoff, Urban runoff, Sewage treatment, Federal jurisdiction

Environmental Protection Agency

J010
CHANGING FEDERAL-STATE RELATIONSHIPS IN WATER POLLUTION CONTROL PROGRAMS,

Cohen, J. L.

Pittsburgh University, Pittsburgh, Pennsylvania

Industrial Water Engineering, Vol. 11, No. 4, p 8-11, July/August, 1974.

A discussion is presented to show why and how the legal system of the Federal Government answered demands for a more effective water pollution control system and, in the process, how the powers of the Federal Government in this area greatly increased and the states' powers decreased. Areas of interest include: the authority of states to regulate the quality of water within their territorial limits (or their police powers); the right of states to commence an action in Federal District Court to restrain a polluter from contaminating the waters of a state from a point outside its boundaries; the doctrine of federal preemption which renders null and void state laws in areas in which Congress has acted (Minnesota was prevented from having more strict laws about nuclear power plants than the AEC allowed); the inconsistencies and confusion that prevailed in the past concerning water pollution control; and the rigorous standards set up by the Federal Water Pollution Control Act Amendments of 1972. The permit system and the issues of the Amendments are discussed. The Amendments basically are a system of regulation that has the Federal Government set the standards for water quality and the state governments are then to supply the manpower to administer and enforce the permit system. The author states that if the governmental officials involved are primarily interested in the control of water pollution, then this new allocation of powers will provide the basis for a more effective and rational water quality control program. However, if the states feel that the system is an infringement of their rights, then the objectives of the legislation will suffer substantially.

*Legislation, *Water pollution control, *Water pollution abatement, Local governments, Federal government, Federal Water Pollution Control Act, Water permits, Regulation, Water law, Government interrelations, Federal-state water rights conflicts

J011
WATER POLLUTION LAW DRAWS FLOOD OF COMPLAINTS,

Chemical Week, Vol. 115, No. 16, p 37, October, 1974.

The Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) were criticized by both industry and municipal spokesmen at the Water Pollution Control Federation Conference in Denver during October. Chief complaints included: the requirement for uniform controls on discharges even though differences in local situations and operations may exist; the large role of the federal government; the lack of adequate financing to meet the goals; the minimal allocations for research; and, the provision which requires municipalities to recover new treatment plant costs in proportion to industrial wastes treated. One basic fault that was found with PL 92-500 is that it is not cost-effective and the goals are not realistic. It is hoped that the National Commission on Water Quality which must report to Congress by October, 1975, will recommend changes in the law which will eliminate the current problems.

*Federal Water Pollution Control Act, *Industrial wastes, *Municipal wastes, *Costs, Government finance, Regulation, Water pollution abatement, Water pollution control, Legislation

*PL 92-500, Environmental Protection Agency

J012
EASING OF ENVIRONMENTAL LAWS?,

Haarhoff, F. E.

Factory, Vol. 7, No. 11, p 29-35, November, 1974. 7 fig, 3 tab.

Current controversy over pollution control and abatement involves warnings from many people on the dangers of relaxing air and water standards, while many industry spokesmen urge the loosening of environmental rulings as an anti-inflation measure. Industry leaders are asking the government to weigh the public benefits from the regulatory programs against the public costs such as price increases resulting from passing on the costs of pollution abatement programs and jobs lost from the diversion of funds from installation of production plants. The EPA took 2846 enforcement actions against violators of water, air and pesticide laws between January, 1973, and March, 1974; fines and penalties imposed on polluters since December, 1970, total over $8,200,000. The EPA has developed an effective, quick-acting enforcement team to insure that the environmental laws will achieve cleaner air and water and safer use of pesticides. Industries have realized the penalties for polluting and have begun long-range plans of pollution abatement. The majority of companies responding to a recent survey of industrial pollution control expenditures state that neither future energy conservation programs nor higher energy prices will have significant effects on their long-range anti-pollution efforts. Some of industry's newest pollution control techniques will have applications also for sewage and water treatment. Ozone may soon replace chlorine as the acceptable water purifier. The use of ozone for the treatment of effluent water from a sewage plant is able to economically meet Public Health Service requirements for potable water.

*Water pollution abatement, *Industrial wastes, *Pesticides, *Regulations, *Legislation, Ozone, Sewage treatment, Water purification, Waste water treatment, Public health, Potable water

Environmental Protection Agency

J013
EFFECTS OF CHLORINATED HYDROCARBON POLLUTANTS ON GROWTH OF MARINE PHYTOPLANKTON IN CULTURE,

Fisher, N. S.

Dissertation Abstracts International B, Vol. 35, No. 6, p 2917, December, 1974.

An evaluation was made of the applicability of batch and continuous culture toxicity tests to natural ecosystems. Six species of marine planktonic algae were subjected to polychlorinated biphenyls and DDT in various concentrations. Their growth was studied as affected by these compounds. Both artificial communities and natural communities of the algae were observed. Due to an impermanence of conditions in aquatic environments and the relatively low phytoplankton cell densities normally occurring, most phytoplankton species will adopt a density-dependent strategy, involving such mechanisms as allelochemics. By interfering with competitive abilities of some phytoplankton, chlorinated hydrocarbons were found to disrupt successional patterns and to alter species composition in algal communities in nature. Animal communities would be indirectly affected as many herbivores graze selectively.

*Toxicity, *Hydrocarbons, *Pollutant effects, *Algae, Chlorinated hydrocarbon pesticides, DDT, Polychlorinated biphenyls

J014
THE EFFECT OF CERTAIN ORGANIC POLLUTANTS ON COPPER TOXICITY TO FISH (LEBISTES RETICULATUS),

Black, J. A.

Dissertation Abstracts International B, Vol. 35, No. 5, p 2244, 1974.

A new methodology, anodic stripping voltammetry (ASV) was used to measure the degree of copper-organic binding in bioassay solutions. The relative toxicities of several copper-organic complexes to fish and the relationship of the binding abilities of the organic ligands for copper were studied. Guppies were exposed to copper-organic complexes during 96 hour bioassays conducted in soft water at pH of 7.5. Fish were analyzed by atomic absorption spectrophotometry to determine the amount of copper accumulation in internal organs. The organic compounds tested were chosen on the basis of their prevalence as pollutants. Glycine, cysteine, EDTA, NTA, and citric acid were tested in the concentration range of 1 to 3 times ten to the negative six M. Albumin, humic acid, and secondary sewage effluents had concentrations of 5.0 mg/liter. The organic compounds found to reduce copper toxicity to fish included NTA, glycine, EDTA, and humic acid. Those with no effect on toxicity were albumin, sewage effluent, cysteine, and citric acid. The conclusion reached was that organically bound copper is less toxic than unbound copper. The methodology of ASV was detailed as a possible technique to predict metal toxicity in natural waters.

*Pollutant effects, *Organic matter, *Toxicity, *Copper, Fish toxins, Bioassay, Sewage, Metals

Anodic stripping voltammetry, Organic pollutants

J015
PROGRAM FOR CONTROL OF DISCHARGES OF POLLUTANTS TO NAVIGABLE WATERS,

Kirk, A. G.

Federal Register, Vol. 39, No. 244, p 43759, December 18, 1974.

The United States Environmental Protection Agency has granted the State of Hawaii's request for approval of its program for controlling discharges of pollutants to navigable waters in accordance with the National Pollutant Discharge Elimination System (NPDES). This is in accord with section 402(b) of the Federal Water Pollution Control Act, as amended, and provides that a state may administer its own permit program for discharges into navigable waters within its jurisdiction after approval of such a program by a Federal Administrator. On August 30, 1974, Hawaii submitted a program for carrying out the NPDES. On October 10, 1974, EPA conducted a public hearing on the proposed approval of Honolulu, Hawaii. As of November 29, 1974, the Hawaii NPDES permit program was approved, to be administered by the Hawaii State Department of Health.

*Waste discharge, *Federal jurisdiction, *State jurisdiction, Hawaii, Federal Water Pollution Control Act, Administration, Navigable waters, Permits

Pollutant discharge, Environmental Protection Agency

J016
TAR POLLUTION OF SIERRA LEONE BEACHES,

Okera, W.

Sierra Leone University,
Freetown, Sierra Leone, West Africa,
Institute of Marine Biology

Nature, Vol. 252, No. 5485, p 682, December, 1974. 1 fig, 2 ref.

Pelagic tar and plastic wastes have been found in parts of the Pacific and Atlantic oceans. Extensive and considerable fouling of the sandy beaches of Sierra Leone, West Africa, by tar lumps has been observed during the 14 months from June 1973 to July 1974. The extent of current pollution suggests that the whole Sierra Leone coastline, and perhaps those of flanking countries as well, may be subject to frequent tar pollution, probably originating from the heavy, offshore traffic of tankers and ships. During ebb tide, at Lumley Beach, tar lumps and other debris are deposited on the sand in a series of crescent-shaped aggregations by the receding waves. The lumps are inhabited by a variety of marine organisms such as colonies of small goose barnacles, and ghost crabs (Ocypode spp.).

*Oceans, *Plastics, Ships, Pollutants, Marine life

Sierre Leone, West Africa, Pelagic tar, Tankers, Tar pollution

J017
PROGRESS AMIDST PROBLEMS,

White, L. J.

Chemical Engineering, Vol. 81, No. 22, p 7-10, October 21, 1974. 3 tab.

Guidelines set under the 1972 Federal Water Pollution Control Act have been challenged by the chemical industries on three grounds: procedural challenges (that is, which court has jurisdiction); claims of factual mistakes; and arguments against the Environmental Protection Agency's interpretation of the Act. For example, a controversy in interpretation is the use of "guidelines" and "limitations". One viewpoint is that Congress intended the EPA to use general guidelines for effluents to define a range of discharge levels. These figures would then be used to write NPDS permits, which would give limitations for each individual situation. The EPA, however, uses limitations as standards or requirements for a particular industry. Guidelines were issued in 1974 for thirty industries; a standard or regulation, once issued, must be challenged within 90 days or be accepted. The industries, listed in the order for which guidelines were made in 1974 are: fiberglass insulation, beet sugar, feedlots, glass, cement, phosphates, rubber, ferroalloys, asbestos, meat products, inorganic chemicals, cane sugar refining, grain mills, fruits and vegetables, electroplating, plastics and synthetics, nonferrous metals, fertilizers, leather tanning, soaps and detergents, timber products, organic chemicals, petroleum refining, builders paper, dairy, pulp and paper, seafood, iron and steel, textiles, and steam and electric.

*Federal Water Pollution Control Act, Water pollution control, Effluent, Industrial wastes, Legislation

Chemical process industries, Effluent guidelines

J018
P.L. 92-500 (TWO YEARS LATER) IS NOT THE ANSWER!,

Heckroth, C.W.

Water and Wastes Engineering, Vol. 11, No. 12, p 34-40, December, 1974.

Industries as well as waste water and consulting sanitary engineers have been critical of P.L. 92-500 (the Federal Water Pollution Control Act) since its start. Its industrial cost recovery provisions have been called discriminatory against industry unless residential and commerical connectors also are required to return their share of federal grants for facilities construction. At the annual meeting of the Water Pollution Control Federation, both P.L. 92-500 and the EPA position were criticized for the ambiguity of zero discharge provisions; the substantial demands imposed upon the States, the missed or unrealistic deadlines, the uncoordinated planning requirements, almost total federal control of the programs, paperwork in hugh proportions, and the lack of practical experience in water pollution control of a large number of personnel at the Washington EPA level. It was recommended, and supported by State water pollution control administrators that: EPA regulations and guidelines be simplified; more responsibility be given to states and regions; planning requirements be made realistic; State Program Grants be restructured so that funds are provided to States to develop their own individual programs; and a simple program for monitoring progress be devised.

*Federal Water Pollution Control Act, Waste water, Industrial water, Federal jurisdiction, State jurisdiction, Water pollution control, Costs

Environmental Protection Agency, Effluent guidelines, P.L. 92-500

J019
EPA'S EFFLUENT GUIDELINES HAVE THEIR DAY IN COURT,

Chemical Week, Vol. 115, No. 18, p 33-34, October 30, 1974.

Out of 30 guidelines issued by the EPA under its interpretation of the Water Pollution Control Act Amendments, 21 have been challenged in court. The major challengers are the chemical process industries, who disagree with the legal interpretations of "best practical" (for 1977) and "best available" for (1983) pollution controls. Inorganic chemicals guidelines have already been challenged in court and other petitions for future review include those against guidelines for organic chemicals, soaps, detergents, phosphates, plastics and synthetics, rubber, nonferrous metals, petroleum refining, fertilizers, pulp and paper, and textiles. Three main arguments have been set forth: although Congress intended guidelines for use by states and regional EPA offices in setting effluent limits for individual permits, the guidelines for existing plants have been treated by EPA as mandatory national standards; EPA did not follow the 1972 Act amendments in carrying out cost-benefit analyses to determine whether the proposed additional cleanup costs bring sufficient return in environmental improvement; and, EPA based its pollution control guidelines on a few exemplary plant operations, not considering problems of older plant performance, or of climatic and regional differences. Discharge permits for industrial plants were to have all been issued by December 31, 1974. It was expected that less than two-thirds of these will have been issued by the deadline. Legal maneuvering is expected to continue, due to the ambiguities of the Act.

*Legislation, Federal jurisdiction, Water Pollution Control Act Amendments, Industrial wastes, Effluents, Chemicals, Environmental effects

Chemical process industry, Effluent guidelines, Environmental Protection Agency, Court action

J020
SAFE DRINKING WATER HAS BECOME A FEDERAL CASE,

Chemical Week, Vol. 115, No. 22, p 46, 51, November, 1974.

The discovery of alleged carcinogens in drinking water from the Mississippi River is accelerating the demand for federal drinking water standards. The Safe Drinking Water Act of 1974 was passed by the Senate late last year; the House has recently enacted their version. The bills do not specify drinking water standards or methods of treatment. Instead they require the EPA to propose standards within 90 days of enactment, and make the standards final within another 90 days. The House version of the bill requires the EPA, with the assistance of the National Academy of Sciences, to determine maximum contaminant levels as well as the contaminants which may have an adverse effect on the health of humans. Federal drinking water standards could be a mixed blessing for the chemical industry--sales of water treatment chemicals would be boosted but new restrictions on plant effluents and on use of some chemicals might also result. The oil industry is objecting to the bill as it would prohibit underground injection which is currently used to help extract oil from depleted wells. Disinfection by chlorination is also under investigation. It is thought that some of the byproducts of chlorination might possibly be carcinogenic. Ozone and hydrogen peroxide can be used as substitutes for chlorine. Ozone has been used to eliminate phenols from Whiting, Indiana, water for almost 20 years. Costs of meeting new water quality standards, that will result if the new bill becomes a law, will be high, perhaps a doubling or tripling of existing costs.

*Public health, *Potable water, *Standards, *Legislation, Water supply, Water treatment, Water purification, Chlorine, Ozone, Chemical industry, Oil industry

*Safe Drinking Water Act, Carcinogens, Hydrogen peroxide

J021
FEASIBILITY TEST PROGRAM OF APPLICATION OF COALESCING PHASE OIL/WATER SEPARATORS TO SELF COMPENSATING FUEL TANKS IN SURFACE SHIPS,

Arnaiz, J. B., and Batutis, E.

Re-entry and Environmental Systems Division, General Electric Company, Philadelphia, Pennsylvania

National Technical Information Service Report AD 784 105, May, 1974. 90 p, 17 fig, 7 tab, 6 ref.

An evaluation was performed of the General Electric Coalescing Plate Oil/Water Separator concept as applied to ballast water discharged from a ship that has self compensating fuel tanks. Flow rates of up to 1200 gallons per minute were processed. At all times, the amount of oil discharged in the effluent of the separator was 5 ppm or less. The influent oil values to the separator were as high as 800 ppm and at the end of the test the influent to the separator contained almost 100 percent oil. A commercially available General Electric OPC-100 oil/water separator was chosen for the tests because it has a cross sectional area and volume very close to the equivalent of a DE-1040 forward fuel tank. On-line measurements of entrained particle size and number were obtained for both the influent and effluent; on-line turbidity was measured for the effluent only. The data from these measurements substantiated those obtained by chemical analysis. This test program demonstrated the technical feasibility of the proposed self compensating fuel tank coalescing plate oil/water separator concept for reducing the water pollution during fueling operations. Fuel which was previously discharged with the ballast water can now be retained in the ship's fuel tank and used.

*Oily water, *Separation techniques, *Water pollution sources, *Oil-water interfaces, Oil wastes, Oil pollution, Fuels

Coalescing plates, Oil/water separator

J022
MANUAL FOR PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS FOR WASTEWATER TREATMENT WORKS, FACILITIES PLANS, AND 208 AREAWIDE WASTE TREATMENT MANAGEMENT PLANS,

Cook, P. L., and Cronin, N.

National Technical Information Service Report No. PB 235 280, August, 1973. 35 p, 3 fig.

Detailed guidance is given for the preparation of Environmental Impact Statements (E.I.S.) on waste water treatment works. The National Environmental Policy Act of 1969, Public Law 91-190, requires all Federal agencies to prepare environmental impact statements before acquiring Federal funds to produce a project. The requirements of the Council on Environmental Quality (CEQ) are outlined for the preparer. A flowchart for the systematic gathering of information for the EIS has been drawn. Various treatment alternatives are listed, depending upon whether the facility is a treatment work, a facilities plan, or a 208 plan. Techniques such as treatment and discharge to surface waters, waste water reuse, land application, and sludge disposal alternatives are described. Alternatives for both point sources and nonpoint sources are given. The review of the EIS by a Federal or State Agency representative is also discussed.

*Federal jurisdiction, *Environmental effects, *Treatment facilities, Waste water treatment, Waste discharges, Publications, Pollutant effects, Planning

*Environmental Impact Statement, Manuals

J023
WASTE OIL IN MARYLAND: A POLLUTANT OR A RESOURCE?,

Long, M. T.

Maryland Environmental Service

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, Washington, D. C., Information Transfer, Inc., Washington, D.C., p 43-54. 2 ref.

A study was performed by the Maryland Environmental Service and the EPA to determine the amounts and characteristics of waste oils in Maryland and to design a program for the collection, transportation, processing and use of these oils. The design constraints were that all of the waste oils generated in the State be accepted, that the majority of the waste oils be converted into fuel, that the present technology be used and that environmental protection be strongly considered. An estimated 18.5 million gallons of waste oil were generated in Maryland in 1972. Maryland has the technology to feasibly collect all of the waste oils produced in the state, to process these oils into fuel oils and to dispose of non-processable oils and residues in an environmentally acceptable way. Such a waste oil recovery and reuse program is outlined. Mathematical modeling of collection and transportation systems, preliminary plant design, market analysis and the constraints imposed, indicate that the program can be self-supporting at volumes greater than 30 mgy. The proposed program would have several advantages including: alleviation of fuel oil shortages during the winter months; reduction of environmental damage to the water, land, and air resources of Maryland; reduction of high volumes of waste oil spills and the attendant cost of clean-up; prevention of waste of a resource; and reduction of maintenance cost in sewers and municipal treatment plants.

*Oil, *Oil wastes, *Waste disposal, *Oil industry, Water pollution sources, Industrial wastes, Fuels, Maryland

J024
WASTE LUBRICATING OIL CHARACTERISTICS--DO THEY VARY GEOGRAPHICALLY, SEASONALLY, AND WITH ORIGIN?,

Carter, R. C.

Getty Oil Company

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 73-90. 14 tab.

The American Petroleum Institute is studying the characteristics of waste lubricating oils as the first phase of a project to determine how to make economic use of these used oils. The raw analytical data from samples representing winter driving conditions from thirteen representative locations throughout the continental U.S. are presented. The second phase of the project will involve burning tests to demonstrate the feasibility of burning small ratios of waste fuel oil blends without significant impacts on the environment. The continental U.S. was divided into five geographical areas--Pacific Coast, Rocky Mountain, Plains States, East Coast, and Mid-West Rural--then from each of the first four of these zones three cities or city areas were selected to have samples taken from it. As an example of the data, table one sets out the results from the Pacific Coast zone and Los Angeles, California area. Water content, flash point, ASTM distillation to 450 F, sulfated residue, aluminum, barium, calcium, copper, iron, lead, magnesium, phosphorus, sodium, zinc, total bromine, and total chlorine, and sulfur contents were determined on the hydrocarbon layer. Samples came from three service stations, a truck fleet, a taxi fleet, an off road fleet, a city composite sample and a collection service.

*Oil, *Oil wastes, *Waste disposal, *Oil industry, Industrial wastes, Water pollution sources, Laboratory tests

Lubricating oils, American Petroleum Institute

J025
WASTE OIL: THE RECAPTURE OF AN ENERGY RESOURCE (THE GENERATION, DISPOSAL AND RECOVERY OF WASTE OIL IN THE NEW YORK METROPOLITAN AREA),

Maltezou, S.

Council on the Environment of New York City

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 55-69. 5 tab.

Although the data collection of this study was restricted to the New York Metropolitan area, the importance of this area as an industrial, commercial, urban and suburban center permits the observations and methodology at this local level to be used to assess the waste oil situation in comparable areas, both nationally and internationally. The main findings of this study are in the following categories: quantities of waste oil generated by type and location of users of oils; methods of disposing of waste oil by users of oil, approximate quantities of waste oil disposed of, and cost of each method of disposal; systems of collection and outlets for the collected waste oil and percentages of waste oil diverted to the outlets of collection; ways of reusing waste oil, such as re-refining, dust and weed control, and percentage of oil used in each way; quantities of waste oil processed by re-refineries and reprocessors in the New York metropolitan area; quantities of fuel and lubricants used in the New York metropolitan area and the degree to which an optimal recovery system of available waste oil could supplement them; and, general trends in the disposal, recovery and reuse of waste oil.

*Oil, *Oil wastes, *Waste disposal, Oil industry, New York, Industrial wastes, Water pollution sources

New York (NY), Re-refining

J026
DISPOSAL OF USED CRANKCASE AND OTHER OILS IN CANADA,

Skinner, D. J., and Strigner, P. L.

Environment Canada

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-24, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 29-41. 11 ref.

The waste oil problem in Canada is discussed. Topics include: the formation of the Petroleum Association for Conservation of the Canadian Environment (PACE); the volumes of new and used oils; the storage and collection of waste oils; disposal methods for waste oils such as road oiling, re-refining and reclamation, land fill, fuel blends, and incineration; and, legislation involving used oil and its disposal. The following conclusions were reached: an estimated greater than 40,000,000 gallons of used crankcase oil are generated in Canada annually; when all waste oil is considered the amount may be as much as 70,000,000 gallons; a variety of storage/collection techniques are operative; disposal of waste service station and other crankcase oils is varied--road oiling is the most common, followed by re-refining, land fill, combustion as fuel and incineration in that order; undesirable features of the disposal methods are environmental pollution and irretrievable loss of resource; investigations to improve some of the disposal methods are increasing; legislation at the different levels of government is aimed largely at controlling pollutional aspects; and, governments and the petroleum industry are showing an increased interest in disposal because of antipollution pressures and also the energy shortage. Recommendations include: the creation of an active, voluntary, national body comprising representative personnel from the oil industry, oil disposal firms, and various levels of government; Statistics Canada and PACE should gather more detailed statistics on the availability of used oils with emphasis as to the types and source; and, extension of change periods for oils to prolong their use should be studied.

*Oil, *Oil wastes, *Oil industry, Legislation, Governments, Canada, Waste disposal

J027
WASTE OIL MANAGEMENT--THE ENVIRONMENTAL PROTECTION AGENCY'S ROLE,

Lederman, P. B., and Jakobson, K.

United States Environmental Protection Agency

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 19-27. 11 ref.

The Environmental Protection Agency has been concerned with waste oil for the past three years. The concern was started by reports that these oils were entering water courses. The current EPA program emphasizes resource recovery with environmental control. The two primary sources of waste oil are crankcase oil and industrial oil. Other sources include oil recovered from spills, tank cleanings, and ballast water. In the past, the EPA has had a multi-faceted program in waste oil management. Programs funded include waste oil management studies, development of institutional programs, and evaluation of existing technology and methodology. In connection with process development, the EPA has funded a major program to develop a non-polluting process for re-refining and recovering waste oils for use as diesel fuel and/or lubricants. One of the major problems that hampers industry is the disposal of the sludge remainders from re-refining, therefore the EPA is also sponsoring work to develop acceptable means of disposing of the re-refining sludges. In addition to working to solve the problems of re-refining, the EPA is also sponsoring programs to develop waste oil collection systems and models. Concerning the evaluation area, the EPA has contracts to obtain data on waste oil generation, waste oil utilization, and the engineering evaluation of current waste oil re-refining processes. French and German methods of dealing with waste oils are also discussed.

*Oil, *Oil wastes, *Oil industry, *Water pollution sources, Waste disposal, Oil pollution, Foreign research

Environmental Protection Agency, Re-refining, France, Germany

J028
THE SOURCE AND SUPPLY OF VIRGIN LUBES,

Twomey, D. W.

Sun Oil Company

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 9-16. 6 fig.

The lube fraction of the oil barrel and where the supply and demand for lubes fits into the overall petroleum conservation problem is discussed. Manufacturing lube oils is an expensive procedure in both capital and operational cost; relatively few barrels of crude oil within a refinery system are made into lube--only 3-6% in a fully integrated refinery. The supply of lubes is not easily or inexpensively increased by additions to existing plants while the demand for lubes has grown rapidly during a period of declining capacity. Two solutions are offered for meeting our national objectives of an adequate supply for the domestic market and maintaining our foreign markets for profit and trade balance: the addition of domestic capacity to produce additional lubes; and, the conservation of lubes. There is a large percentage of lubes that can be recovered. These include railroad engine lubes, transformer oil, industrial hydraulic oil, circulating oil for lubrication, industrial gear oil, emulsifiable cutting oils, and gas absorption oil. These oils can be economically recovered for secondary use because they exist in large quantities in relatively few locations and the large volume has already created a disposal problem. The pressures of supply, cost and proper disposal should work together to make reconditioning or re-refining a large and valuable business.

*Oil, *Oil wastes, *Oil industry, Waste disposal, Oil pollution, Industrial wastes

Lube oils, Re-refining

J029
OIL REUSE--A NATIONAL NEED,

Weinberger, L. W.

Environmental Quality Systems, Incorporated

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 197-, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 5-7.

The necessity for holding a national conference on waste oil reuse is discussed. Oil waste is one of the few pollutional problems whose solution would meet the criteria of: improving environmental quality of water, air, and land; conserving energy; conserving resources; and, making obvious economic sense. The facts that are known about waste oils include: waste oils can be re-refined; they are a resource which can be utilized to reduce energy and oil shortages; they are curreutly being disposed of in ways which cause environmental degradation; certain practices related to oil disposal such as uncontrolled use as a fuel should be prohibited; most oil re-refiners in business ten years ago have gone out of business; and, both the Federal Water and Air Quality Acts put tighter controls on disposing of waste oils. In addition, effective waste oil collection, treatment, and reuse system must include storage, collection, treatment, distribution and sale, licensing, monitoring and surveillance, financing and legislation ordinance as well as roles for all segments of society to play in the development of such a system. The author suggests that the reason there is presently no viable oil reuse system is that no one seems to have the responsibility or is willing to assume the responsibility of putting the necessary programs together. That is, the institutional aspects appear to be of more significance than the technical or economic aspects.

*Oil, *Oil wastes, *Oil industry, Fuels, Water pollution sources, Oil pollution, Waste disposal

Waste oil recovery, Waste oil reuse, Re-refining

J030
ENVIRONMENTAL ACTION AT PORT AUTHORITY AIRPORTS,

Attar, A. M.

The Port Authority of New York and New Jersey

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 99-116. 19 fig, 5 tab.

The Port Authority of NY and NJ is conducting a comprehensive program to protect and improve the environment around the airports under its jurisdiction. In 1971, Calspan Corporation of Buffalo was retained by the Port Authority as a consultant on a far-reaching program developed to provide for analysis of airport discharges, recommend short-term control measures and propose long-term preventive solutions. Short-term recommendations are: increase water pollution control unit staff; intensify tenant education programs; increase inspection and surveillance; establish sanctions against deliberate and inexcusable abuse of tenant leases; establish policy of imposing established sanctions; perform oil water separator testing; segregate wash waters from other wastes in hangars; use vacuum pick up scrubbers for ramp washing; test high pressure water systems for runway cleaning; perform experiments to test surface spray disposal of cresylic acid runway washing solutions; encourage reporting of accidental spills. Long-term recommendations include: treatment of all hangar and maintenance facility wastes; centralized deicing facilities with holding tanks for used ethylene glycol-melted ice solutions; derubberizing runways; design and installation of tide gates at various outfalls; installation of belt skimmers in various sumps; installation of chlorination systems; installation of upstream booms to aid in spill tracing; installation of upstream booming areas for spill cleanup; installation of French wells where leaks are detected; and, installation of a centralized monitoring system.

*Oily water, *Oil wastes, *Pollution abatement, *Water pollution sources, *Airports, Oil pollution, Oil spills, Oil, Fuels, Industrial wastes, Port Authority of New York

J031
DISPOSAL AND/OR RECYCLE OF AIR FORCE WASTE PETROLEUM OILS AND LUBRICANTS,

Kroop, R. H., and Lieberman, M.

United States Air Force

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 117-129. 4 fig, 5 tab.

The disposal of Air Force waste petroleums, oils, and lubricants (POL) is a complex and serious problem. Efforts that have been conducted in determining how waste POL products could be more effectively disposed of or recycled are discussed. Topics considered include the generation of waste POL's at Air Force installations, the collection and segregation of such wastes, disposal and recycle alternatives, and the reprocessing of synthetic turbine lubricants. None of the several disposal and recycle alternatives available are universally applicable. A highly desirable solution at one installation may not be at all feasible for another installation even though both installations may generate the same types and volumes of waste POL's. The contractor pickup for ultimate disposal or recycle option involves the least effort for base personnel, but provides only a low, if any, monetary return. On-base disposal by fuel downgrading on combustion in existing boilers involves extra handling but can be widely applied and contributes to solving both environmental problems and energy shortages. The reprocessing and recycle of synthetic turbine lubricants shows definite potential and must be evaluated from the viewpoints of product reliability and economics.

*Oil wastes, *Recycling, *Waste disposal, *Waste treatment, Oil pollution, Pollution abatement, Aircraft, Airports, Water pollution sources

U.S. Air Force

J032
THE NAVY'S OILY WASTES HANDLING AND DISPOSAL PROGRAM,

Kinney, E. T., and Grant, N. G.

Naval Material Command

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 133-147. 3 fig, 4 tab, 11 ref.

An outline is given of the Navy's oily wastes handling and disposal program. The program has two main goals: to prevent in every possible way the generation of these wastes; and, to utilize a total system approach at naval complexes to provide maximum utilization of existing, modified, and new disposal/reclamation facilities. In the fiscal year 1973, the Navy used more than 90 million barrels of fuel oil and related petroleum products. Due to the nature of the total oil management system and utilization requirements within the Navy, a variety of oil wastes are produced, both ashore and afloat. The measures being taken to prevent oil spills and to reduce the volumes of oily wastes to be disposed of will have a significant effect on the requirements for waste oil treatment and disposal facilities. The facilities will require a total system concept including collection, transportation, storage and treatment/disposal. Corrective action for wastes from naval ships includes: installation of pipe risers from bilge pumps to deck connections on the main deck to offload oily wastes; increases in waste oil holding tank capacities; installation of reliable tank level indicators; modification of aviation fuel reclamation systems; and, reduction of the volume of bilge wastes. In fiscal year 1974, a military construction program was authorized which includes the improvement of the oil collection and reclamation facilities at Norfolk, Jacksonville, and Oakland. The ship to shore transfer of oily wastes is being improved through the construction of 17 donuts of the closed bottom concept and the design of an oil/water separator system to provide clean-out services for the donuts.

*Oil wastes, *Oily water, *Equipment, *Waste treatment, Oil spills, Construction, Waste disposal, Facilities, Ships, Fuels, Oil, Pollution abatement, Water pollution sources

J033
OILY BILGE FROM COMMERCIAL VESSELS,

Waller, R.

Environmental Quality Systems, Incorporated

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 185-199. 4 tab.

A grant has been provided to the Seaway Port Authority of Duluth (Minn) to characterize the sewage, bilge, ballast, dunnage and garbage from the various vessels that enter Duluth Harbor. The major marine waste categories include: sanitary sewage; other sewage; garbage/refuse; dunnage; ballast water; cargo loss; tank washing; and, spilled cargo. Over sixty samples of sanitary sewage, bilge, ballast, garbage and dunnage were taken from commercial vessels entering Duluth Harbor. Preliminary analysis of the data indicates a broad variability in volume and characteristics of the bilge water. The conclusions of the study are as follows: the oil content and total volume of bilge waters varies considerably between vessels; diesel-driven vessels appear to generate a bilge water that can be quite high in oil content although the volume of bilge water generated is less than that from steam-driven vessels; the bulk of the data presented is for vessels with no onboard oily waste control system; and, waste oil re-refiners expecting to handle bilge water must be prepared to accept a highly variable feedstock. More definitive conclusions will be made after the remainder of the data are obtained and the entire results are analyzed.

*Oily water, *Ships, *Water pollution sources, *Oil pollution, Pollutant identification, Fuels, Oil wastes, Recycling, Port authorities, Minnesota

*Bilge water, Re-refining industry, Duluth (Minn)

J034
SHIPYARD PROBLEMS WITH OILY WASTES,

Clark, A. C. K.

Shipbuilders Council of America

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 201-205.

In the past, the receiving and disposing of oily wastes from ships by shipyards has been an opportunity for economically alert shipyards. The shipyards could profit doubly by this--charging ships a fee for offloading their oily wastes and then saving on the cost of purchasing fuel by separating and then burning the oil from the ships. Receiving slop barges were towed out to ships at anchorage or at piers, to be loaded with slop oil and towed ashore for disposal of the wastes. Powered barges with centrifuges received many thousands of gallons of oil wastes, pumping the centrifuged water back into the harbor. Shipyard settling tanks separated the remaining oil and water; the residual water was pumped into the harbor. However, current regulations place limitations on the amount of oily water that can be released to a harbor and also on the amount to harmful emissions that are allowed from the burning of fuels. The regulations provide that no oil or oily water may be dumped into the harbor that would create a visible sheen on the surface. Equipment to reduce the amount of residual oil in oily wastes to such low levels is not currently available, therefore, alternate methods of slop disposal must be found. The quantities of wastes received by shipyards may seem small to the oil re-refining industry, but they are large problems for shipyards that do not have suitable disposal facilities. Such facilities are economically non-viable for individual shipyards to build and therefore should come under the control of port authorities.

*Ships, *Oil wastes, *Oily water, *Waste disposal, Recycling, Water pollution sources, Facilities, Waste treatment, Port authorities

*Shipyards, Re-refining

J035
CHARACTERISTICS OF OIL POLLUTION IN AND AROUND U.S. WATERS,

Van Voorhis, P. W.

U.S. Coast Guard Headquarters

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 207-224. 6 fig, 5 tab, 8 ref.

One of the effects of the 1972 amendments to the Federal Water Pollution Control Act was to extend and strengthen the U.S. Coast Guard's regulatory authority for the control of oil and hazardous substances discharged into U.S. coastal waters. The oil pollution problem in the U.S. today, and the Coast Guard's growing program to combat it are discussed. The main emphasis is on the oil discharges which have occurred in or upon U.S. waters between 1970 and 1972, concentrating on frequency, volume, causes and characteristics, as well as the problems and expense associated with removal. The Coast Guard has been developing a pollution response program which involves field personnel organized to effectively respond to a pollution incident, district and Headquarters coordinating and administrative elements, and equipment to be utilized by field personnel in containment and removal activities. The Chemical Hazard Response Information System (CHRIS) was developed and placed in operation during the spring of 1974. CHRIS provides field personnel with the necessary information to make an effective response to discharges of hazardous polluting substances. The Coast Guard's research and development program has been working toward the development of equipment to be utilized in offshore and fast current oil discharges. Research has also been aimed toward reducing the quantity of oil released, controlling the spread of released oil, and removing oil from water.

*Oil pollution, *Coast Guard regulations, *Pollutant identification, *Oily water, *Oil wastes, Water pollution, Oil-water interfaces, Oil spills, Water pollution sources, Federal Water Pollution Control Act

U.S. Coast Guard, Chemical Hazard Response Information System (CHRIS), 1972 Federal Water Pollution Control Act Amendments

J036
A PROGRAM FOR HANDLING EMERGENCY OIL SPILLAGES IN THE PORT OF BALTIMORE,

Wilcox, R.

Maryland Port Administration, Baltimore, Maryland.

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 225-235. 8 fig.

The Maryland Port Administration has been responsible for the removal of debris and oil from the waters of Baltimore Harbor. A State law passed in 1970 gave the additional responsibility to the Port Administration of developing a program which would enable the State to respond to an emergency oil spillage in the Baltimore Harbor area. The Maryland Port Administration has not only assembled a growing inventory of sophisticated equipment designed to remove oil and debris from the harbor waters with maximum efficiency and effectiveness, but has also taken a primary role in encouraging and coordinating the work of governmental agencies and private industry to assist in the minimization of the incidence of spills in the Baltimore Harbor area. In 1962, the PORT SERVICE, a small tank vessel with an oil recovery system, was acquired. In the bow of this vessel is a four-roller, hydraulically powered device which separates and removes oil from the surface of water by the principle of adhesion and cohesion; the oil clinging to the surface of the rotating aluminum drums is wiped off and flows by gravity into the vessel's 3000 gallon cargo tank. The recovered oil is off-loaded via the PORT SERVICE's own cargo discharge system. The PORT RETRIEVER, purchased in 1966, is a self-propelled waterborne front end loader. This boat removes more than one million pounds of debris from the waters of Baltimore Harbor annually. By attaching a hardware cloth insert in the scoop, the PORT RETRIEVER is capable of removing the more viscous oil spills without prior application of any sorbent materials. A waterborne dump truck has also been designed to work in conjunction with the PORT RETRIEVER.

*Oil spills, *Oil pollution, *Water pollution sources, *Oily water, Equipment, Oil-water interfaces, Maryland, Ships, Port authorities

J037
QUALITY PRODUCTS FROM USED PETROLEUM OILS,

Williams, B. R.

Motor Oils Refining Company

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 239-243.

The feasibility and desirability of producing reusable products from waste oil is discussed. A review of the re-refining industry and a profile of the capabilities and benefits of re-refining are presented. The preservation of reusable waste oil to recover the most valuable elements as well as re-refining as a contributor to the solution of the energy shortage are also discussed. The production of reusable products from waste oil is feasible because of the seemingly perpetual characteristics of petroleum oil and it is desirable from the standpoints of both the conservation of irreplaceable natural resources and the abatement of pollution potential. The re-refining industry is moving forward and can be a prime factor in helping to solve the porblems of conservation and pollution. Destruction is no longer the principal solution to waste problems, instead recovery of reusable elements of the waste stream is becoming essential.

*Oil wastes, *Oil, *Recycling, *Oil industry, Natural resources, Conservation, Resources development, Pollution abatement, Water pollution sources

*Re-refining, *Re-refining industry

J038
THE ECONOMICS OF RE-REFINING,

Weinstein, N. J.

Recon Systems, Incorporated

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 245-260. 4 fig, 4 tab, 11 ref.

The economics of re-refining waste oils and alternative methods of disposing of crankcase waste oils are discussed. Although re-refining cannot readily compete on an economic basis with road oiling or dust control or with the direct use of drain oils as a fuel component, these methods of disposal do not overcome the environmental problems of disposal. Alternatives to the above methods are: re-refining to produce lubricating oil blending stocks; processing to produce clean fuel oil; controlled combustion to produce steam; and, use as a fuel where adequate particulate control systems exist or can be economically installed. Costs are presented for the following re-refining processes: acid/clay treatment; propane extraction/acid/clay treatment; distillation/clay treatment; and, distillation/hydrotreating. Vacuum distillation and recovery of fuel products, leaving a bottoms fraction containing solid residues and burning of raw crankcase oil under carefully controlled conditions to recover energy in the form of steam are also examined. Conclusions reached include: acid/clay treatment is a marginal process for producing lube oil; alternative processes are available which are more attractive than acid/clay treatment; only the distillation/hydrotreating process appears to be a economically attractive process producing no waste products; distillation to produce clean fuels does not seem attractive in comparison to lube oil production; controlled combustion with steam recovery can be attractive where a steam market exists; and, refining of crankcase waste oils to produce lube oil stocks can be an economically feasible and desirable way to recycle up to about 500 million gallons of this waste oil.

*Oil wastes, *Waste disposal, *Recycling, *Economics, Waste treatment, Lubricants, Fuels, Pollution abatement

J039
POLLUTION CONTROL WITH A COMPREHENSIVE WASTE OIL PROCESSING PLANT,

Guntz, G. D.

Environmental Quality Systems, Incorporated

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 261-279. 2 fig, 9 tab.

The design of a plant for the reuse or disposal of waste oils generated in Maryland is discussed. For preliminary design purposes, a single processing facility was postulated which has the potential to treat all the waste oils generated on a state-wide basis. The following design needs were considered: treatment or disposal of all types of waste oils that are collected within Maryland; production of fuel oil; the total waste oil recovery and reuse system need not produce a profit; compliance with all current and projected State and Federal environmental standards; use of existing technology; and, capacity of the plant to be based upon 1975 estimates. Plant design and the specification of unit operations depend on the expected flow(s) for the process in question and the product(s) desired. The following processes were selected to be included in the preliminary design of a waste oil processing facility: chemical treatment; settling; flash distillation; adsorbent treatment; solvent extraction; and, filtration. Ultimate disposal of process residues and non-recoverable waste oils must be as efficient and environmentally sound as other operations of the plant. Of the six ultimate disposal methods considered, total incineration was chosen because it minimizes the environmental impact of ultimate disposal, produces a concentrated relatively pure residual, places ultimate disposal practices primarily under the control of the processing facility, increases the flexibility of the facility for comprehensive waste oil recovery/disposal, and eliminates any possible oil pollution problems due to process residues.

*Oil wastes, *Waste treatment, *Pollution control, Facilities, Design, Maryland, Ultimate disposal, Incineration, Distillation, Filtration

*Waste oil recovery/disposal plant

J040
EXPERIENCE WITH THE IFP PROPANE CLARIFICATION PROCESS IN RE-REFINING SPENT CRANKCASE OILS,

Vu Quang, D., Andrews, J. W., Carriero, G., Schieppati, R., and Compte, A.

Institut Francais du Petrole

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 281-287. 2 fig, 7 tab.

A process is described which was developed by the French Petroleum Institute (IFP) for propane clarification of spent lube oils prior to conventional acid/clay treatment. The process is simple and low cost and can easily fit into overall re-refining operations. Viscolube Italiana, an IFP licensee, has shown by experience that the IFP process lowers the amounts of acid and clay needed, reduces sludge formation and associated pollution, and improves product quality. The yields are much higher than for conventional acid/clay treatment alone and the plant investment and operating costs are low. The process is well suited for re-refining multigrade motor oils formulated with high concentrations of pour point improvers, viscosity index improvers and other additives, and containing large amounts of varnish, gums and other asphaltic compounds. Four grades of re-refined oil are produced by Viscolube Italiana. These are compared with corresponding lube oils derived from virgin stocks. The color, acid number, and Conradson carbon are better for the propane-clarified oils. Viscolube Italiana has been able to market re-refined oils on a competitive basis with lubricants prepared from virgin stocks. This process also greatly reduces pollution by reducing the amount of acid sludge that must be disposed of. Three industrial plants have been licensed by IFP (Viscolube Italiana, Magnisi Italiana, and a Yugoslavian plant) which are designed for a total of 121 tons/year.

*Oil wastes, *Waste treatment, *Recycling, *Lubricants, Economics, Oil industry, Sludge, Waste disposal, Pollution abatement 740

J041
RE-REFINING DIESEL LOCOMOTIVE LUBRICATING OIL,

Leibenow, W. F.

Chessie System

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Inc., Washington, D. C., p 295-297.

The success that the C&O Railway has had in using re-refined lube oil in their diesel locomotives is discussed. The C&O from 1952 to 1959, re-refined its own lube oil drainage from diesel locomotives. A batch vacuum distillation unit with press frame filter was used. Additives were added in mixing tanks and the oil pumped into new oil supply tanks. The oil that was produced by this process met the same specifications that were used for new oil and worked in a diesel locomotive in regular service over a long period of time as well as if not better than new oil. No lubrication problem has ever been discovered that was caused by re-refined lube oil. Economics and an exploded plant caused the C&O to start sending their waste oil out to be re-refined in 1959. The control measures for re-refined oil should be the same as for new oil-- for both products the C&O runs tests to insure compliance with their specifications. Disadvantages of re-refining include: collecting and transporting the drainage to the re-refiner and returning the finished product; the close control necessary of the collected material; and, the bias of locomotive builders against re-refined oil. Advantages of using re-refined oil include: a net saving over new oil of between 15 to 20 percent; the product varies less than new oil since the C&O gets back their own drainage; the re-refiner will add the additive of the C&O's choice; and, re-refining conserves oil.

*Oil wastes, *Recycling; *Waste treatment, *Railroads, Economics, Lubricants, Conservation, Pollution abatement

*Re-refining, C&O Railway

J042
CIVIL ENGINEERING LABORATORY DEVELOPS UNIVERSAL CONNECTOR FOR ALL BOOMS,

Sea Technology, Vol. 16, No. 1, p 16, January, 1975. 1 fig.

One major problem of containing an oil spill is speed and efficiency in completing the operation. This is often inhibited by the time required to connect most commercial oil booms with the variable size interconnecting devices. The Civil Engineering Laboratory (CEL), Naval Construction Battalion Center at Port Hueneme, California, has developed a universal boom connector. This piece of equipment allows sections of different types and sizes to be connected quickly. The CEL design has been accepted by the Navy as a connector for all new booms; presently there are 200 commercial firms making these booms. The CEL design consists of extruded aluminum male and female connectors configured for simple attachment to the ends of already available boom sections. The two booms can be connected in one minute by two men working from a boat, even in rough seas, because the connectors do not have to be aligned. The connector is then attached to the boom by bolts and a metal plate; the connector is held to the boom under tensile loads by a rod running the full height of the boom.

*Oil spills, Water pollution control, Equipment, Design criteria, California, Oceans

Oil booms, Civil Engineering Laboratory, Universal connector

J043
INTERNATIONAL EXPLORATION LOCATES MINERALS AND OILS,

Jennings, F. D.

Office for the International Decade
of Ocean Exploration

Sea Technology, Vol. 16, No. 1, p 29-30, January, 1975.

Exploration by the Living Resources, Seabed Assessment, Environmental Forecasting, and Environmental Quality programs of the International Decade of Ocean Exploration has been conducted in the past two years, and further work is planned through 1977. Studies investigated the location of natural oil accumulations as well as areas of pollution and the effects of pollutants on marine organisms. The goal of these studies is the understanding of the role of the ocean in weather and climate and the knowledge of circulation within the ocean. It was suggested that heavy metals, chlorinated hydrocarbons, and the water-soluble fractions of petroleum hydrocarbons be used to study pollution effects on aquatic life. Data now complete from the Geochemical Oceans Sections Study provide quantitative bases for knowledge of stirring and mixing processes of the sea and exchange of material between deep and surface waters.

*Hydrocarbons, *Oceans, *Petroleum, *Water pollution effects, *Aquatic life, Oil, Climate, Investigations, Metals, Surface waters

Exploration, Mineral location

J044
USCG SETS BROADER USE OF POLLUTION CONTROL SYSTEMS,

Price, R. I.

Office of Marine Environment and Systems,
U.S. Coast Guard

Sea Technology, Vol. 16, No. 1, p 30-31, January, 1975.

In compliance with new discharge regulations since July 1, 1974, a system of surveillance was required to insure earliest possible notice of discharges of oil. The Coast Guard has developed an Airborne Oil Surveillance System. The prototype consists of four pollution sensors. A system of forensic identification and classification of oil spills should make the identification of source more reliable. If the discharge source is among the sources samples, the system should identify the source 99.9% of the time. Further research and development is planned, including new high seas oil barriers, and modification of recovery and containment equipment for use in Arctic climates. With these systems, oil discharge prevention and clean-up from both onshore and offshore facilities transferring oil in bulk to or from vessels should be accomplished.

*Water pollution control, Legislation, Oil spills, Oil pollution, Water pollution sources, Equipment

Offshore facilities, Pollution sensors, Oil recovery, U.S. Coast Guard

J045
WASTE OIL--SOLUTION TO MARYLAND'S ENERGY CRISIS?,

Uhrmacher, J. C., and Pollack, B. L.

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Incorporated, Washington, D. C., p 301-308. 1 fig, 6 ref.

The possibility of the use of waste oil pollution as fuel oil by re-refining is considered. Technical questions regarding such an application are whether reprocessed waste oil can be burned in presently available furnaces, whether furnace maintenance would then be adversely affected, what any environmental effects of burning reprocessed waste oil might be, and what market prospects exist, both short term and long term, for waste oils as fuels. Maryland's Environmental Service is re-assessing the ban on the use of lead-bearing fuels and is at the same time hoping to work to provide a state-controlled source of alternative, lead-free fuel oil manufactured at a state-controlled facility. The facility would eventually accept all oily wastes in the state and either provide conversion or ultimate disposal of them. The Maryland Environmental Service hopes to see State legislation passed requiring all waste oils picked up in Maryland to be deposited at State-owned facilities.

*Oil wastes, *Oil, *Maryland, Costs, Environmental effects, State jurisdiction, Legislation, Waste disposal, Ultimate disposal

Waste reuse

J046
OCEAN POLLUTANTS POSE POTENTIAL DANGER TO MAN,

Seltzer, R. J.

Chemical and Engineering News, Vol. 53, No. 8, p 19-20, February 24, 1975.

Studies are being conducted to assess materials and technologies and their potential impacts on ocean environments. Certain marine pollutants pose no threat at present levels, while others should be carefully monitored. While the oceans should play a useful role in waste disposal, their potential for diluting out harmful effects is limited. A transport model to estimate the mass flow and ultimate fate of pollutants is being developed. Six groups of materials have been chosen for case studies: transuranic elements; synthetic organic chemicals; waste materials, sludges, and sediments dumped or discharged into the ocean; metallic wastes; medicinal wastes; and marine litter. The critical parameters found by the case studies were: rate of release into the environment; persistence in the environment; concentration factors for ocean compartments (such as estuaries or surface films) and bioaccumulation; and toxicity, both long and short range. Two materials of major concern are transuranic elements from nuclear weapons tests and hexachlorobenzene. The latter is the only synthetic organic chemical examined which seems to present a problem. Hexachlorobenzene is resistant to degradation, disperses easily through the food web, and has resulted in wildlife losses worldwide. Its sources are pesticides and wastes from factories manufacturing other chlorinated hydrocarbons. Doubts still remain about the impact of low-molecular weight halogenated hydrocarbons and tetracyclines and of aromatic hydrocarbons.

*Water pollution effects, *Oceans, *Waste disposal, Organic compounds, Model studies, Pollutants

*Hydrocarbons, *Hexachlorobenzene, Transuranic elements, Synthetic organic chemicals

J047
WATER-QUALITY REQUIREMENTS FOR THE PETROLEUM INDUSTRY,

Evers, R. H.

Journal of the American Water Works Association, Vol. 67, No. 2, p 60-64, February, 1975. 2 fig, 10 tab, 5 ref.

A review of water reuse, water quality requirements, current effluent standards and treatment practices for water from the petroleum refinery industry is given. Water usage is divided into cooling and condensing, boiler feed, and process and other uses. Water quality guidelines have been compiled by the American Petroleum Institute. Requirements vary depending upon the future use of the recovered water, whether for potable use or washdown purposes. General guidelines indicate that water should be clear, colorless, free of iron, manganese, hydrogen sulfide, and organic growth. Tables illustrate the quality characteristics of untreated cooling waters, water use and reuse by refinery classification, raw water and reused water for steam and processing, guidelines for boiler feed water tolerances and cooling water tolerances, water quality requirements of water at point of use for the petroleum industry and treatment systems used for refinery raw waters. Effluent standards as established by the EPA are described. Future plans for waste water discharge and for reuse within the industry are being made.

*Water reuse, Water quality standards, Oil, Waste water, Organic compounds, Waste discharge, Industrial wastes

*Petroleum industry

J048
EFFECTS OF AN OFFSHORE CRUDE OIL UNLOADING TERMINAL ON THE MARINE ENVIRONMENT,

James, W. P., Hann, R. W., Jr., and Slowey, F.

Texas A. & M. University
Environmental Engineering Division

Marine Technology Society Journal, Vol. 9, No. 1, p 28-31, January, 1975. 2 fig, 4 ref.

Environmental aspects of a deepwater crude oil unloading terminal have been studied at two stations off the coast of Texas. The first was conducted for the Council on Environmental Quality and the second for SEADOCK, Incorporated, both by Texas A & M University. SEADOCK is a corporation formed to operate a deepwater facility to handle very large crude carriers in the 100,000 to 700,000 deadweight ton class. The construction schedule and its impacts are outlined. Field sampling has been conducted to provide baseline information on the physical, chemical, and biological characteristics of the area, and to estimate the impact of the project on the marine environment. Fuel pipelines, trunklines, pumps, and mooring systems are described. The existence of platform structures, monobuoys and such pipelines should have little adverse impact on the marine environment and may provide an artificial reef for colonization by sessile marine organisms. Oil spill hazards were weighed by models developed which provided information on response time available for control, sections of the coast requiring protection, and concentrations of soluble oil fractions in the water column. The location of an offshore terminal complex was concluded to be the most sound choice environmentally, as any major spills would be less hazardous than in an estuarial inshore area. Transit time to inshore entrances should provide enough time for corrective action in the event of any oil spill.

*Oil spills, Oil pollution, Environmental effects, Sea water, Offshore platforms, Engineering structures, Pipelines, Construction, Water pollution effects

J049
THE EFFECT OF CRUDE OIL FRACTIONS ON THE SURVIVAL OF A TIDEPOOL COPEPOD, TIGRIOPUS CALIFORNICUS,

Barnett, C. J., and Kontogiannis, J. E.

California State University
Northridge, California,
Biology Department

Environmental Pollution, Vol. 8, No. 1, p 45-54, January, 1975. 6 fig, 7 ref.

Oil pollution of oceans is a current ecological problem. The effects of petroleum products of various marine species are not well documented but are now under both field and laboratory investigation. In this case, the effects of four common crude oil fractions on the surface of a tidepool copepod were studied in the laboratory. For Tigriopus californicus, diesel oil, kerosene, gasoline, and benzene were tested. Diesel oil was the most detrimental; in concentrations of 0.10 ml/liter, mortality resulted within five days. Gasoline showed the highest mortality within the first 24 hours while benzene was most lethal between the first and second days. The order of toxicity from greatest to least was diesel oil, kerosene, gasoline, benzene. It was concluded that the more slowly evaporating crude oil fractions present the greatest hazards and that the survival of this species is inversely proportional to the concentration of the crude oil fraction in the environment.

*Oil pollution, *Oceans, *Copepods, Crustaceans, Invertebrates, Laboratory studies, Water pollution effects, Marine animals, Gasoline

Tigriopus californicus, Diesel oil, Kerosene, Benzene

J050
JETTISONING OF LNG AT SEA--AN UNRESOLVED POLLUTION HAZARD,

Marine Week, Vol. 2, No. 5, p 23, January 31, 1975.

Liquefied natural gas may be spilled or jettisoned onto the ocean as a result of collision damage. In addition, if there is a need to lighten a LNG carrier, such as in a disabled vessel, oil may be jettisoned. Another possible source of leakage is if liquefied natural gas is allowed to contact the structural steel of a hull during loading, whereby the cryogenic temperature might lead to an eventual brittle fracture. Tests have been conducted by the Bureau of Mines, the U. S. Coast Guard and the American Gas Association. Results on spillage showed vaporization effects and indicated that the ignition point for an explosion is dependent upon the ratio of propane-to-ethane. A discharge of 10,000 cu m would take less than fifteen minutes to form a cloud 20 feet deep and a mile wide. If such a cloud should drift over other vessels, an oil terminal, or a city, while burning, serious danger would exist. Another pollution hazard with LNG is the disposal of the boil-off, especially when the carrier is in the harbor. There has been controversy as to atmospheric venting of LNG; arguments in favor of this disposal means insist that the methane content is below the explosive limit and that discharge is heated and its density is lower than that of air. Port authorities against atmospheric venting argue that no matter how much preheating, if there is an inversion over the port, gas will not rise. Since 1974, the U. S. Coast Guard has prevented carriers from LNG venting in port.

*Oil spills, Waste disposal, Water pollution control

Liquified natural gas (LNG), Shipping

J051
HEALTH IMPLICATIONS OF EXPOSURE TO TRACE METALS FROM COMBUSTION OF WASTE OIL,

Bridbord, K., Colucci, A., Hammer, D. I., and Moran, J. B.

National Environmental Research Center,
Environmental Protection Agency

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer Incorporated, Washington, D. C. p 367-374, 2 tab, 15 ref.

The health implications that would accompany use of waste oil as a primary fuel by blending with virgin fuel oil were examined, as well as economic aspects of this application. Lead levels were measured for El Paso where a population resides down wind from a smelter and in Philadelphia where children are exposed to high traffic density and industrial lead sources. To evaluate safe concentrations of waste oil in fuel for power plants, the considerations necessary are: capacity of the power plant; concentration of lead in the waste oil; frequency of waste oil combustion; fraction of lead emitted in waste oil; and, nature of the population contiguous to the power plant. No precise limit for allowable quantities of waste oil in power plant fuel have been specified. However, by preliminary analysis, it is suggested that unless well regulated, the burning of waste oil in power plants could represent a serious hazard to populations residing in their vicinity due to lead emission levels.

*Lead, *Public health, Oil wastes, Costs, Power plants

*Waste oil reuse, Health effects, Lead pollution

J052
WASTE AUTOMOTIVE LUBRICATING OIL AS A MUNICIPAL INCINERATOR FUEL,

Chansky, S., McCoy, B. Suprenant, N., and Sahagian, J.

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer Incorporated, Washington, D. C., p 327-365. 8 fig, 8 tab, 54 ref.

Of concern to municipal waste systems are: the recovery of growing quantities of waste automotive lubricating oils economically and without adding to environmental hazards and the levels of air contaminants and organic residue materials presently generated from municipal incinerators as a result of poor combustion. The physical and combustion properties of automotive waste oils were demonstrated to be suitable for auxiliary fuel in a municipal incinerator. It was recommended that the effectiveness of burning waste oil be evaluated for alternative designs, locations, and number of waste oil burners necessary. Criteria for effectiveness include stack emissions levels, residue quality, and burner and incineration maintenance problems. It will then be necessary to quantify the waste oil needed in relation to refuse composition and moisture level; to demonstrate and evaluate monitoring and control systems for firing waste oil burners; to demonstrate and evaluate the waste oil storage and feed system performance; and to verify economic estimates as compared to real costs.

*Municipal wastes, *Oil, Costs, Environmental effects, Oil wastes, Design criteria, Incineration, Monitoring

Automotive lubrication oil, Waste oil, Waste reuse

J053
MASSACHUSETTS WASTE OIL MANAGEMENT ACTIVITIES,

Corey, D. L.

Division of Water Pollution Control,
Commonwealth of Massachusetts

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Incorporated, Washington, D. C., p 309-325. 1 fig, 6 tab, 4 ref, 1 append.

Waste oil disposal problems in Massachusetts are discussed. The Massachusetts Division of Water Pollution Control has the legal responsibility of controlling collection and disposal of waste oil as well as carrying out management activities. The licensing of waste oil collection and disposal firms is required. The largest volume of waste oil comes from automotive lubricating oil; others include hydraulic oils, cutting oils, separators in terminals, railyards, airports, and industrial facilities. Due to economic disincentives such as labelling and excise tax rulings, re-refining of lube oil is no longer practiced in New England, although limited reprocessing of selected waste for fuel oils for special markets still occurs. Three research and development programs for oil pollution control and waste oil dipsosal were conducted; future planning includes a review of licensing requirements and the use of advanced technology to convert waste oil to valuable products. In addition, the Commonwealth of Massachusetts is hoping that the Federal government will act to remove legal and economic obstructions to re-refining.

*Waste disposal, *Oil wastes, *Legislation, *Massachusetts, Industrial wastes, Costs, Planning, Federal jurisdiction, State jurisdiction

*Re-refining, *Waste management

J054
THE WASTE OIL INDUSTRY: A DISCUSSION OF SOME ISSUES TO CONSIDER IN PERFORMING AN ECONOMIC ANALYSIS,

Jaksch, J. A.

In: Proceedings of the International Conference on Waste Oil Recovery and Reuse, February 12-14, 1974, Washington, D. C., Information Transfer, Incorporated, Washington, D. C., p 395-404. 1 tab, 5 ref.

A brief overview is given of some of the issues an economist should consider in undertaking an analysis of the waste oil industry. Waste oil disposal, waste oil collection, waste oil re-refining, and combined industry analysis are considered. Two broad categories of waste oils are industrial and automotive. The first are easier to recover because waste concentration is at the place of use. Of the one billion gallons of annual waste oil produced, an estimated 100 million gallons are re-refined or reprocessed; 200 million gallons are used as road oil, some burned as fuel oil, and about 750 million gallons disposed of with no specific assurances of preventing groundwater or surface water pollution. Cost-revenue comparisons of production of virgin lube oils as opposed to re-refining waste oils are being delineated. Federal Trade Commission and I.R.S. requirements have contributed to a decline in re-refining. Decision making involves an analysis of economic implications and impacts of policy options. Such options for cost-effective and environmentally effective decision include: paying subsidies to recover waste oil; changing current tax laws which encourage use of virgin oil over recovered oil (such as depletion allowances); or specification of federal oil waste recovery policies.

*Oil wastes, *Waste disposal, Industrial wastes, Reuse, Federal jurisdiction, Legislation

Re-refining, Waste oil industry

J055
800 MILES TO GO,

Merrett, R. H.

Alyeska Pipeline Service Company,
Alaska

NLGI Spokesman, Vol. 38, No. 12, p 421-427, March, 1975.

A discussion of the Alaska pipeline and its environmental effects is given. Both Federal and State agencies have been assigned to monitor pipeline work. A two lane 360-mile road is being built along the route of the pipeline as well as shorter auxilliary roads to assure access to the pipeline material, should problems arise. The project is the largest privately funded construction effort ever undertaken, amounting to $4.5 billion before completion. The extreme terrain and temperatures along its 800 miles present unique problems in engineering and design. Water and air quality control facilities in conjunction with the pipeline are a major environmental effort. All ballast water from tankers which take on oil will be processed and purified before being returned to the harbor. Water will be discharged with less than 8 ppm of oil. Problems of long-term management such as cost monitoring, personnel control, and the scheduling of inspections are detailed.

*Pipelines, *Alaska, *Environmental effects, Water quality control, Oil wastes, Monitoring, Costs, Personnel

Alaska pipeline

J056
ICEBREAKING DRILLINGSHIP FOR OFFSHORE EXPLORATORY DRILLING IN THE ARCTIC,

Jones, K. M., and Schaff, J. C.

Journal of Petroleum Technology, Vol. 27, No. 4, p 433-444, April, 1975. 9 fig, 1 tab, 14 ref.

Practical techniques and equipment for drilling off-shore oil must be coupled with an application to specific environmental problems. In the Arctic in particular, a technology involving a drillship and icebreaker combination was required. Environmental protection necessitated the establishment of an ecological baseline, considering variations in water temperature, salinity, dissolved oxygen, pH, nutrients, plankton, trace elements, and turbidity. Icebreaking energy regulations were followed and vessel testing was carefully conducted. Primary pollutant sources from the drillship are discharge of oily ballast, bilge pumping, and disposal of personnel's garbage and sewage. Products of bilge pumping and ballast tank discharge are to be run through a coalescer before being pumped overboard. Disposal plants and incinerators are provided on-ship for sewage treatment. Emergency equipment includes oil-absorbent materials and chemical and mechanical containment means for use in the case of accidental oil spillage.

*Oil, *Drilling, Oil industry, Oil wastes, Environmental effects, Arctic, Cold regions, Waste disposal, Oil spills, Equipment, Water pollution control

Offshore drilling

3057
OIL IN THE SEA,

The Dock and Harbour Authority, Vol. 55, No. 651, p 323, January, 1975.

The United States National Research Council has prepared a report on petroleum hydrocarbons entering the world's oceans. Of six million tons of these hydrocarbons per year, it was estimated that about 35% enter the sea from transportation activities, including tanker bilges, drydocks, terminals operations, and accidents; 31% from river and urban runoff; 13% from coastal refineries and municipal and industrial wastes; 10% from atmospheric fallout; 10% from natural seepage; and 1.3% from offshore oil operations. One year's input of oil is thought to exist on the open sea as floating specks and lumps. Tar masses have appeared in formerly unpolluted areas worldwide, originating primarily from tanker washings and bilge discharges. Reliable information on the rates of biodegradation of oil by microorganisms in the oceans was not available.

*Oil pollution, *Oceans, Urban runoff, Oil industry, Water pollution sources, Water pollution effects, Microorganisms, Biodegradation

National Research Council

3058
MARINE FLOATING SCREEN,

Water and Waste Treatment, Vol. 18, No. 2, p 24, February, 1975. 1 fig.

Five million tons of oil enter the sea annually according to experts. The use of floating screens would greatly restrict the escape of this oil. The floating screen discussed is called "Seaboom" and is composed of elements each 24 feet long and consisting of a 36 inch high and 1/4 inch thick vinyl plate, which floats on a tube, standing upright in the water and extending 12 inches above the surface. The synthetic resins which comprise the screen are resistant to seawater, ice, heat and loads under storm conditions. The Seaboom can be used to contain oil spilt through transport and transhipment, oilwell drilling and waste disposal of refineries and industry. The Seaboom is available in floating and submersible versions. The submersible Seaboom has made it possible to seal off harbors and water areas in case of oil hazard in a matter of minutes.

*Oil pollution, *Oil spills, *Water pollution treatment, Oil-water interfaces, Oily water, Equipment

*Seaboom

J059
RECOVERING OIL SPILLS FROM WATER,

Water and Sewage Works, Vol. 122, No. 4, p 73, April, 1975.

A new oil sweeper ship and oil-water separator system has been introduced by Hydrovac Systems International, Inc. The system has been successfully tested in the port of Rotterdam, the Netherlands. The major function of the system is to collect oil that is lost because of tanker leaks and ship collisions as well as from leakage and accidents at oil terminals and offshore drilling sites. The oil-water mixture is collected by the oil sweeper boom and pumped through hoses to the oil-water tank and the purified water is discharged overboard. The Hydrovac oil-water separator divides oily water automatically into oil and essentially oilfree water. The separation is effected by mechanical methods and requires no chemicals, electronics, or supervision. When used to full capacity, the separator meets the 1973 specifications of the Intergovernmental Maritime Consultative Organization. With a smaller throughput, the separator is capable of meeting the stringent U. S. requirements of an effluent water with less than ten ppm oil.

*Oil pollution, *Oil spills, *Water pollution treatment, Oil-water interfaces, Oily water, Separation techniques, Water pollution, Equipment

J060
GROWTH OF BARLEY IRRIGATED WITH WASTEWATER SLUDGE CONTAINING PHOSPHATE PRECIPITANTS,

Kirkham, M. B., and Dotson, G. K.

National Environmental Research Center,
United States Environmental Protection Agency,
Cincinnati, Ohio

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 97-106. 9 tab, 16 ref.

It has been unclear as to whether wet sludges containing precipitated phosphates can be used agriculturally. To investigate the use of chemically-treated sludges, barley was grown for 16 weeks in pots of loam soil, and was then irrigated for 7 weeks with wet sludges. Raw primary sludge and primary sludges from alum and ferric chloride addition to raw waste water, either limed or unlimed, were added at two different rates. The rates corresponded to a total application of 23 or 46 m tons/ha/yr. The total and extractable phosphorus in the soil and the elemental composition of the plants were determined. Results showed that barley irrigated with three types of sludges grew as well as those supplied with inorganic fertilizer. However, fertilized plants yielded more grain than sludge-treated plants. Liming significantly decreased extractable phosphorus only in the iron-treated soil. Ninety-two percent of the phosphorus added by the sludges remained in the sludge crust throughout the experiment. On a short-term basis, for growing barley, it was shown that the presence of phosphate precipitated by Al or Fe did not limit growth and that sludges containing phosphate precipitants may be used.

*Irrigation, *Sludge, *Phosphates, *Fertilizers, Agriculture, Barley, Lime, Alum, Sludge treatment

Ferric chloride

J061
UTILIZATION OF DIGESTED CHEMICAL SEWAGE SLUDGES ON AGRICULTURAL LANDS IN ONTARIO,

Black, S. A.

Ontario Ministry of the Environment,
Province of Ontario, Canada

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 107-113. 1 fig, 2 tab, 3 ref, 1 append.

The most common method of sludge disposal currently utilized in Ontario, Canada is anaerobic digesting followed by dumping into sanitary landfills or disposal onto farmers' fields. While land application is frequently used, it is looked upon as a disposal practice rather than as a type of fertilizer. The agricultural value of sludge is discussed, as well as possible hazards due to the leaching of heavy metals. Ontario has had a phosphorus removal program which will seriously affect 150 of its treatment facilities by the end of 1975. About 85 percent of Ontario's sewage treatment plants will practice phosphorus removal by that time, considering the benefits and hazards involved with the nutrients, heavy metals, long chain organics, and microorganisms found in sludge and their effects on soils, crops, groundwater, and surface waters. Guidelines have been prepared for the utilization of processed organic waste by land application. These assume that organic waste has been processed by anaerobic or aerobic digestion or other suitable processing at a municipal water pollution control plant and that land application is defined as utilizing the waste for agriculture, not merely disposing of the sludge. Requirements for the site location, land characteristics, site management, waste application rates, and waste hauling and spreading equipment are detailed.

*Sludge disposal, Canada, Agriculture, Metals, Nitrogen, Phosphorus, Waste disposal, Land use, Sewage sludge

*Land application, Sanitary landfills

J062
THE ECONOMICS OF SLUDGE IRRIGATION,

Troemper, A. P.

Springfield Sanitary District,
Springfield, Illinois

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 115-121. 5 tab.

Discharge of liquid anaerobically digested sludge to an experimental plot was begun in 1965 by the Springfield, Illinois Sanitary District. Irrigation continued through 1971, with crops being planted both on the sewage treated area and on a control area. Costs and benefits in terms of crop yield for each season are enumerated. It was concluded that irrigation of cropland with liquid digested sludge is a valid disposal method for municipal sludge. Spray irrigation proved to be the most practical method of application, although wind drift must be taken into account. Given a sufficient amount of land, the method is economically competitive with alternative methods of disposal. The operation requires minimal attention and creates no odor nuisance, so long as the sludge is reasonably well digested. In designing a system for liquid sludge disposal, a permanent disposal area with a sloped distribution system will allow operation in severe winter months without additional problems; with provision of a good underdrainage system, the possibility of groundwater contamination is minimized.

*Sludge disposal, *Sewage treatment, *Irrigation, Liquid wastes, Drainage, Planning, Design criteria, Anaerobic digestion

Waste discharge, Spray irrigation, Springfield (Ill.)

J063
COMPOSTING SEWAGE SLUDGE,

Epstein, E., and Willson, G. B.

Biological Waste Management Laboratory,
Agricultural Research Service,
U. S. Department of Agriculture,
Beltsville, Maryland

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 123-128. 3 fig, 1 tab, 5 ref.

The composting of sewage sludge was investigated at a pilot plant at the Blue Plains Wastewater Treatment Plant in Washington, D. C. Sewage sludge has seldom been composted by itself, and various types of bulking agents were tested in order to determine which materials and in what ratio to the sludge gave the desired density and moisture content. The optimal bulking agent was wood chips, incorporated with sludge at a ratio of 3:1, chips to sludge. The operation of the composting site at Beltsville, Maryland is detailed. Two major operational problems were how to compost digested sludge under adverse weather conditions and how to compost raw sludge without odors. The addition of material such as chopped hay, straw, or shredded paper to digested sludge accelerates its composting. Further research is being done on odor prevention, using microbiological, chemical, and mechanical methods. Efficient management and coordination between the sewage treatment plant and the composting site is necessary. Public relations when planning such a composting project are important, as the compost has a range of uses by community groups. Direct cost-benefit relationships have not been computed; the composting of sewage sludge now has the goal of reducing sludge disposal costs from waste water treatment plants rather than being a profit-making venture.

*Sewage sludge, *Fertilizer, Sludge disposal, Waste treatment, Costs, Digestion, Public relations, Planning, Odors

Composting, Blue Plains (Washington, D. C.)

J064
AGRICULTURAL UTILIZATION OF DIGESTED SLUDGES FROM THE CITY OF PENSACOLA,

Edmisten, J. A.

Baseline, Incorporated,
Pensacola, Florida

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 177-182. 9 fig, 5 tab, 4 ref.

Previous to 1974, the digested liquid sewage sludge from the Pensacola Main Street Sewage Treatment Plant was disposed of by dumping the material at a sanitary landfill 18 miles away. In 1973, a study was conducted by the County Commission of Escambia County Florida and the City Council of Pensacola for a one year experiment, using liquid digested sludge for agricultural production on deep sandy coastal plains soils. The experiment used greenhouse experiments to establish the rates of sludge application tolerable to tomatoes, corn, and a variety of horticultural materials. Test fields and plots have been designed to control application. When soils are too wet for direct application, tankers carrying sludge dump it into a holding lagoon. Precautions against bacterial hazards are being tested by feeding dried sludge to test animals, which will be slaughtered after six months and their tissues examined. Small test plots are being grown with varying rates of sludge applications; crop responses so far seem to be similar to those of earlier greenhouse studies. With organic matter accumulation, it is likely that cyst nematodes, a pest to soybeans, will be destroyed, thus yielding better corps. Additional research projects for agricultural utilization of sludge are ongoing.

*Sludge disposal, *Agriculture, Sewage treatment, Soils, Florida, Land use, Lagoons, Bacteria

*Liquid digested sludge, Land application

J065
INSTITUTIONAL PROBLEMS ASSOCIATED WITH SLUDGE DISPOSAL,

Brough, K. J.

Washington Suburban Sanitary Commission,
Hyattsville, Maryland

In: Proceedings of the National Conference on Municipal Sludge Management, June 11-13, 1974, Pittsburgh, Pennsylvania, p 183-186. 4 ref.

Public attitudes on sludge disposal cause institutional problems which affect regulations for municipal sludge treatment and disposal. In one example, at the Piscataway (Maryland) Wastewater Treatment Plant, incineration was used for sludge disposal. Citizens alleged that incinerator test operations caused high blood lead levels in area children; EPA and the County Health Officer could not substantiate any evidence of a health hazard. However, a resolution was passed that stopped incineration until some undetermined time when it is proven conclusively that no health hazard exists. The Washington Suburban Sanitary Commission, which controls the Piscataway facility, has millions of dollars invested in the incinerators. In addition, tests for the potential health hazard, ironically, cannot be performed without operating the incinerators and quantitatively measuring their output. It was recommended for the future that the public be involved in planning decisions and that the impact of institutional problems will be minimized if the public forms its values and attituted before disposal methods are in operation.

*Public rights, *Public health, Information, Regulations, Municipal wastes, Waste water treatment, Sludge disposal, Treatment facilities, Incineration, Environmental effects, Planning

Piscataway (Maryland)

J066
MUNICIPAL SLUDGE MANAGEMENT, PROCEEDINGS OF THE NATIONAL CONFERENCE ON MUNICIPAL SLUDGE MANAGEMENT,

The Pittsburgh Section of the American Society of Civil Engineers and the U. S. Environmental Protection Agency, Pittsburgh, Pennsylvania, 1974. 218 p.

Twenty-seven papers as well as the keynote and closing addresses of the National Conference on Municipal Sludge Management are presented. The conference took place in Pittsburgh, Pennsylvania, from June 11 to 13, 1974. Engineers, environmentalists, consultants, and municipal and federal administrators were participants, coming from many United States cities. Several papers dealt with specific unit analyses of the methods of sludge handling and disposal. These included: sludge thickening, sludge dewatering, incineration, heat treatment, pressure filtration, composting, ocean disposal, trench incorporation, and pasteurization of liquid digested sludge. Treatment facilities at individual cities were described, detailing those at Chicago (Ill.), Denver (Colo.), Speedway (Ind.), Blue Plains (Washington, D. C.), Cedar Rapids (Iowa), Ontario (Canada), Philadelphia (Pa.), Pensacola (Fla.), St. Louis (Mo.), and Twin Cities (Minn.). The economics of sludge, as a profitable by-product of waste water treatment, are illustrated by its market value as a fertilizer, by experiments with sludge irrigation of agricultural crops, and by its value in the reclamation of soils lacking organic nutrients. The effects of public relations, federal legislation, and water quality standards on sludge management are also examined.

*Reviews, *Sludge disposal, *Sludge treatment, *Treatment facilites, Incineration, Filtration, Dewatering, Thickening, Digestion, Secondary treatment, Legislation, Regulations, Water quality control

*Composting, Sludge management, Conferences, Pittsburgh (Penna.), State-of-the-art reviews

J067
IMPLEMENTATION OF WATER SUPPLY AND WASTEWATER PROGRAMS IN THE WASHINGTON, D.C. METROPOLITAN AREA,

Winklehaus, C.

American Society of Civil Engineers,
Water Pollution Task Force,
Environmental Engineering Committee

Publication of the American Society of Civil Engineers, July, 1974. 39 p, 2 fig, 7 tab, 35 ref.

An evaluation of the existing waste water treatment facilities in the metropolitan Washington area was made and recommendations for improvement are given. The area is served by three water systems which are not connected and the combined available storage of treated water in the separate systems totals only about one day's supply. Based on the fact that peak demands have exceeded the low flow record, the situation is critical. On the basis of past problems, organizational changes, the funding situation, urban planning and growth, and general water use, several recommendations were made. These included the follwing actions: within existing management organizational structure, new means for reacting rapidly to problems should be found; design should be completed and construction begun immediately on interconnections between the three major water systems; a comparison of damages which would occur as a consequence of short-term water shortages versus the costs of a guaranteed fully adequate supply at all times should be made; investigations should begin of waste water treatment methods, to be planned for the entire region; disputes in the future should use as a model the new agreement on waste flows and sludge disposal, now implemented by the District of Columbia, Maryland, and Virginia, in order to facilitate administrative cooperation; and, costs of water and sewerage systems must involve the public in decisions regarding both money and space for treatment facilities.

*Treatment facilities, Planning, Water supply, Municipal water, Investigations, Water use

*Washington, D. C.

J068
A GUIDE FOR STATE CERTIFICATION OF WASTEWATER FACILITIES PERSONNEL,

Guy, L. L., Jr.

Water Pollution Control Federation,
Washington, D. C.

National Technical Information Service Report No. PB 232 005. March, 1973. 29 p, 1 tab.

Certification of personnel in water pollution control facilities has become an accepted practice throughout the United States. Jurisdiction for making certification optional or mandatory is under the auspices of the states. Movements have voiced concern that the diversity of programs weakens their effectiveness, and a national association of state programs may be formed. Efforts of the Environmental Protection Agency have stimulated the development of information needed to upgrade vocation skills in operating and managing waste water facilities, including planning, training, and certification programs. This guide details the requirements for an effective state program, and is a preliminary to nationally approved guidelines. Discussed are the results of six state surveys conducted since 1972, a model law from 1966 which promotes the concept of certification but allows each state to determine its details and types of operator classifications from the entry level trainee up to the class IV plant superintendent, with qualifications for each. Difficulties with written examinations, renewal requirements, and enforcement problems are discussed.

*State jurisdiction, *Personnel, Water pollution control, Treatment facilities, Waste water treatment, Guidelines, Legislation, Surveys

*Certification, Qualifications

J069
DESIGN CRITERIA FOR MECHANICAL, ELECTRIC, AND FLUID SYSTEM AND COMPONENT RELIABILITY,

Technical Bulletin EPA-430-99-74-001. 54 p.

As a supplement to the federal guidelines on design, operation, and maintenance of waste water treatment facilities, this document details design criteria for municipal waste water treatment works. Minimum standards are given for reliability for mechanical, electric, and fluid systems and components. These criteria are necessary for design of waste water treatment facilities seeking Federal financial assistance under PL 92-500. Definitions of such terms as component, controlled diversion, design flow, effluent limitation, hydraulic capacity, navigable waters, and reliability are given for use in this bulletin. Three classes of treatment works are given: discharge into navigable waters that could be permanently or unacceptably damaged by effluent in only a few hours (near reservoirs for potable water or areas of shellfish); discharge into navigable waters which might be damaged by continued (over several days) effluent quality degradation (such as recreational waters); and a third classification of all discharges not included in the previous two. Works design criteria are detailed, regarding: works location; provisions for expansion or upgrading; piping requirements; pipes subject to clogging; pipe draining provisions; feed line maintenance and repair; component access space, repair, and handling; and essential services. Systems design criteria are enumerated, and include the electric power system, instrumentation, and sludge handling systems.

*Design criteria, *Municipal wastes, Discharges, Navigable waters, Federal jurisdiction, Guidelines, Legislation, Potable water, Effluents, Hydraulic capacity, Pipes, Maintenance, Treatment facilities

Mechanical systems, Electrical systems, Fluid systems

J070
AGRICULTURAL BENEFITS AND ENVIRONMENTAL CHANGES RESULTING FROM THE USE OF DIGESTED SLUDGE ON FIELD CROPS,

Hinesly, T. D.

Metropolitan Sanitary District of Greater Chicago,
Chicago, Illinois

N.T.I.S. Technical Report No. PB 236 402. 1974. 375 p, 83 fig, 164 tab, 173 ref.

The effects of digested sludge application on the chemical composition of soil, plant, and water samples from a large field lysimeter facility are discussed. Specific hygienic aspects of digested sludge were also investigated. It was found that viruses are not likely to survive the heated anaerobic digester environment. Although digested sludge contains large populations of fecal coliform bacteria, these organisms die rapidly during storage and after spreading on the soil. Results from green house and field studies indicate that several crop plants show favorable responses when fertilized with digested sludge. As long as digested sludge application rates do not exceed those which will result in unacceptable concentration levels of NO_3-N in drainage or groundwaters, sludge of the quality employed in this study can be safely used to increase the production of quality crops.

*Viruses, *Sludge, Land use, Soil, Water samples, Public health, Groundwater, Agriculture, Fertilizers, Drainage, Water quality control

Digested sludge, Sludge application

J071
WASTE WATER SURVEY,

Chanute AFB,
Illinois

Technical Report No. AD784784. July, 1974. 39 p, 3 append.

Data and a discussion of the results of a field waste water survey conducted by the USAF Environmental Health Laboratory, Kelly AFB, Texas, at Canute AFB, Illinois, in May 1973 are presented. Physical, chemical, and biological sampling and analyses of the sewage treatment facilities and the receiving stream of the base were accomplished. Existing waste water treatment facilities do not provide an effluent that meets current of projected requirements. Extensive addition and modification or a complete new facility is required to comply with local discharge standards which require as little as four mg/liter BOD5 and five mg/liter of suspended solids in the effluent. This can be achieved with advanced waste treatment methods. In addition, action is required to insure that industrial waste waters are not discharged to the storm drainage system and that the sanitary sewer lift pumps do not overflow to the storm drainage system.

*Surveys, *Sewage treatment, Sampling, Treatment facilities, Water quality standards, Waste discharge

Advanced waste treatment, Storm drainage system, Chanute AFB (Illinois)

J072
SURVEY OF WASTEWATER DISCHARGE--ELMENDORF AFB, ALASKA,

Thomas, J. F., and Pauls, C. F.

USAF Environmental Health Laboratory,
Kelly AFB, Texas

Technical Report AD782480. July, 1974. 11 p, 9 ref, 5 append.

A waste water survey was completed at Elmendorf AFB, Alaska during the period of June 16-22, 1973. Waste water sources, discharge routes and treatment processes were evaluated. Recommendations were made for future handling of wastes from specified operations. Additional recommendations were made regarding fungicides used on the golf course and storage and disposal of waste lubricating oils, fuels and solvents. A sampling and analysis program was outlined to comply with applicable water quality standards.

*Surveys, *Waste water, *Waste disposal, Waste water treatment, Sampling, Analysis, Water quality standards

*Alaska

J073
WATER, SEWERAGE AND FLOOD CONTROL SYSTEMS PLAN AND IMPLEMENTATION PROGRAM 1973-74,

National Technical Information Service Report PB-231 409, December, 1973. 61 p, 4 tab.

The Water, Sewerage and Flood Control Systems Plan and Implementation Program presents the goals and policies for the provision, planning, and extension of water, sewerage, and flood control facilities and services in the San Diego region of California. A summary of an evaluation of the adequacy of the existing facilities to meet present and projected 1981 requirements and a list of proposed projects which are partly based on this evaluation are also presented. The work is in five parts: the introduction explains San Diego County and the Comprehensive Planning Organization; part 2 sets forth the goals and policies to guide the planning and development of water, sewerage and flood control facilities; part 3 discusses the adequacy of the water resources and existing water resource facilities in the region; part 4 outlines improvements as well as financial considerations; and, part 5 discusses the implementation of the systems in relation to governmental responsibilities and organization.

*Waste water treatment, *Sewerage, *Flood control, *Local governments, Facilities, Sewage treatment, Planning, Water resources development, Water utilization

J074
PROCESS DESIGN MANUAL FOR SLUDGE TREATMENT AND DISPOSAL,

EPA Technology Transfer Publication EPA 625/1-74-006, October, 1974. 155 fig, 105 tab.

This manual gives a review of current sludge processing technology as well as procedures to be considered, modified, and applied for specific design situations and unusual conditions. Regulations now require the design and construction, as well as cost-effective operation, of municipal treatment facilities to remove at least 85% of influent BOD. Discussed are the capital, operating, and maintenance costs for both primary and higher levels of treatment. Since higher treatment levels are more costly, there is an economic incentive for optimal design. Advanced waste treatment sludges and complex industrial wastes present unique problems. Secondary treatment produces biological sludges in increasing amounts. Because of a lack of regulations on sludge disposal, design has focussed on liquid treatment handling. This has caused the sludge disposal methods, often disproportionate in terms of cost, to be inefficiently designed. Newer liquid treatment and sludge treatment unit processes in secondary plants are better interrelated and should be studied together. Optimum innovative design by the engineer is discussed. It is recommended that the designer: develop and maintain a thorough knowledge of various sludge treatment unit processes; continually study plant operation for feedback for future cost saving design modifications; study pilot plants of alternate prescreened systems; and use systems analysis to compare alternate complete systems.

*Publications, Capital costs, Operating costs, Maintenance costs, Sludge treatment, Sludge disposal, Design criteria, Pilot plants, Liquid treatment, Reviews, Systems analysis

Manuals

J075
LAND DISPOSAL OF SEWAGE SLUDGE-VOLUME I,

Guelph University, Guelph, Ontario, Canada

Environment Canada Research Report No. 16, Project No. 72-5-17, 1973. 39 p, 3 fig, 10 tab, 8 ref, 1 append.

A study was undertaken to determine the maximum rates at which sludge resulting from chemical treatment for phosphorus removal can be applied to agricultural land without polluting ground and surface waters with elements or organisms harmful to humans or animals, or reducing the quality or quantity of the crops produced. The following parameters of sludge application to soil were investigated: rate of nitrogen transformation to soluble forms when chemical sludges were incorporated into sand-soil mixtures; bacterial contamination of runoff and groundwater; macromorphology, micromorphology, and chemical and physical states of the soil prior to application; effect of sludges on plant growth; and nutrient and heavy metal uptake by plants. A preliminary evaluation showed that Fe(-) and Ca(-) treated sludges do not inhibit nitrogen transformation in soils and that Al(-) treated sludge does. The rate of nitrogen transformation in the field may be dependent on the type of sludge applied. Fall application of sludge is associated with a reduced input of microorganisms to the runoff water, while winter application is associated with an increased input. A 4450 lb N/acre rate of sludge was found to be excessive for good crop growth at the initial stages. Phosphorus and heavy metal losses from the sludges used seemed to be insignificant.

*Sludge disposal, *Ultimate disposal, Phosphorus, Microorganisms, Land management, Runoff, Groundwater, Crop production, Soil, Rates of application, Waste water treatment

Land disposal

J076
LIMITATIONS OF USING A SIMULATION MODEL OF THE SOIL UNDER IRRIGATED CULTIVATION TO SIMULATE THE FUNCTIONING OF THE SOIL AS A PURIFYING SYSTEM (LIMITES D'UTILISATION D'UN MODELE DE COMPORTEMENT DU SOL SOUS CULTURE IRRIGUEE POUR SIMULER LE FONCTIONNEMENT DU SOL COMME SYSTEME EPURATEUR),

Graffin, P.

Annales Agronomiques, Vol. 25, No. 2/3, p 157-177, 1974. 4 fig, 14 ref.

The use of a simulation model of the soil under irrigated cultivation was aimed at forecasting the results of organic wastes purification by the soil and subsequent environmental effects. Researchers in the United States considered such a model, combining the dependent factors of: water circulation in non-saturating conditions; ionic exchanges between the solid phase and liquid phase; displacement of soluble elements; transformation of organic matter in aerobic conditions; and water and nitrate absorption by plants. This DUTT model is not applicable for general waste spreading on land or for conditions involving evolution in an anaerobic medium. The model is, however, useful for land application of wastes under classical agricultural practices involving moderate quantities of organic matter. Composition of the drainage water as well as any changes in soil composition, are central variables in programming this model.

*Model studies, *Simulation, Irrigated land, Land use, Drainage, Soil water, Groundwater

*Land disposal

J077
THE EFFECTS OF FREE AMMONIA AND FREE NITROUS ACID ON THE NITRIFICATION PROCESS,

Anthonisen, A. C.

Dissertation Abstracts International B, Vol. 35, No. 5, p 2154-2155, 1974.

Research has been conducted on the accumulations of nitrite as observed in soil, natural waters and waste treatment systems which receive industrial, agricultural, and municipal wastes. The hypothesis postulated was that un-ionized ammonia (FA) and un-ionized nitrite (FNA) are inhibitory to nitrifying organisms and their effects cause nitrites to accumulate and persist. Both laboratory and pilot plant tests were completed to investigate the reaction rates for the organisms Nitrosomonas and Nitrobacter. Results indicated that FA inhibition to Nitrobacter occurred at concentrations much lower than those required to inhibit Nitrosomonas. Nitrites thus accumulated without subsequent oxidation to nitrate. In liquid waste systems, accumulation of nitrite was shown to be directly related to concentrations of FA and FNA and independent of pH, ammonia and nitrite concentrations. FA inhibits Nitrosomonas nitrification at 10.0 to 150.0 mg/liter; FA inhibits Nitrobacter at 0.1 to 1.0 mg/liter; and FNA inhibits Nitrosomonas and Nitrobacter nitrification at 0.22 to 2.6 mg/liter concentration. It appears possible to control the nitrification patterns that occur during the oxidation of ammonia using operational procedures that consider the inhibitory effects of FA and FNA.

*Ammonia, Nitrification, Municipal wastes, Waste water treatment, Nitrites, Nitrates, Pilot plants, Microorganisms, Bacteria

Un-iodized ammonia (FA), Un-iodized nitrite (FNA), Nitrobacter, Nitrosomonas

J078
CALCIUM SULFATE SOLUBILITY IN BRACKISH WATER CONCENTRATES AND APPLICATIONS TO REVERSE OSMOSIS PROCESSES: POLYPHOSPHATE ADDITIVES,

Yeatts, L. B., Lantz, P. M., and Marshall, W. L.

Oak Ridge National Laboratory,
Oak Ridge, Tennessee,
Chemistry Division

Desalination, Vol. 15, No. 2, p 177-192, 1974. 7 fig, 2 tab, 12 ref.

Most naturally occurring brackish waters contain substances that may foul reverse osmosis membranes, such as magnesium, calcium, and sulfate ions, and small amounts of hydroxide ion. The extent to which saline water can be concentrated with hyperfiltration or by the reverse osmosis process to recover pure water is dependent upon the saturation precipitation of these substances. The solubility at 25 C of $CaSO_4 \cdot 2H_2O$ (gypsum) was investigated for three brackish waters at reverse osmosis plants in Gillette, Wyoming, and Webster, South Dakota, and from the Wellton-Mohawk post-irrigation canal in Arizona. It was found that sodium hexametaphosphate, when added in small amounts, produces an apparent increase in the saturation concentration of $CaSO_4$. Calculations for maximum water recoveries and relationships to the reverse osmosis process were discussed.

*Desalination, Reverse osmosis, Precipitation (chemical), Water reuse, Potable water, Water treatment

*Calcium sulphate, Wyoming, Hyperfiltration

J079
A WATERBORNE GASTROENTERITIS EPIDEMIC IN PICO RIVERA, CALIFORNIA,

Mahoney, L. E., Friedmann, C. T. H., Murray, R. A., Schulenburg, E. L., and Heidbreder, G. A.

Los Angeles County Health Services Department, Los Angeles, California, Immunization Project

American Journal of Public Health, Vol. 64, No. 10, p 963-968, October, 1974. 3 fig, 4 tab, 10 ref.

An outbreak of acute nonspecific gastroenteritis occurred between July 29 and August 7, 1971 when about 11,000 residents of Pico Rivera, California, became ill. Symptoms included diarrhea, stomach cramps, nausea, vomiting, fever, and menatochezia. These symptoms are compatible with the syndrome of sewage poisoning. Sanitary and epidemiology investigations determined that the source of the illnesses was water from a reservoir serving part of the town. Chlorination at the reservoir was interrupted for about a week starting July 29, 1974 due to an unattended chlorinator that was out of chlorine. The area served by the reservoir showed heavy fecal coliform contamination in water samples taken. The contamination was further localized to a portion of the water line. Although the common feeling is that waterborne gastroenteritis outbreaks in the United States are things of the past, current statistics suggest that common source outbreaks of waterborne disease may continue to occur with some frequency.

*Public health, *Epidemics, *Chlorination, *Water supply, Reservoirs, Coliforms

*Sewage poisoning, Fecal coliform, Gastroenteritis

J080
THE USE OF SOIL AS A PURIFYING SYSTEM (L'UTILISATION DU SOL COMME SYSTEME EPURATEUR),

Catroux, G., Germon, J-C., and Graffin, P.

Laboratoire de Microbiologie des Sols,
Centre de Recherches De Dijon,
Dijon, France

Annales Agronomiques, Vol. 25, No. 2-3, p 179-193, 1974. 1 fig, 3 tab, 36 ref.

Filtration, retention and transmission of water, and aeration and retention of dissolved matter are discussed. The different functions of the soil system in purification are given, stressing the action of microflora and exportation by plants. Means of control in purification by soil are analyzed. Data are compared concerning the purification of waste water by soil and agronomic data on the evolution of organic matter. It was concluded that soil should be capable of purifying about 1,200 kg DCO per hectare per day. Details of the practical uses of soil as a purification system and the disposal of waste water are mentioned.

*Waste treatment, *Soil, *Organic matter, *Purification, Aeration, Waste disposal, Filtration

Soil mechanics

J081
THE ECONOMY OF VARIOUS METHODS FOR DEWATERING SLUDGE FROM BIOLOGICAL PURIFICATION (UEBER DIE WIRTSCHAFTLICHKEIT VERSCHIEDENER VERFAHREN ZUR ENTWAESSERUNG VON BIOLOGISCHEM KLAERSCHLAMM),

Lohmann, J.

Chemie-Ingenieur-Technik, Vol. 46, No. 20, p 852-856, 1974. 9 fig, 2 ref.

Sludge from biological purification can be dewatered in several steps and by equipment with varying costs and operating properties. On the basis of experimental results, capital costs, and operating costs, the influence of flocculant consumption on the dewatering costs is examined for the vacuum filter, the band press, and the centrifuge. If costs for the various dewatering apparatuses are calculated to include subsequent incineration, they will depend upon whether organic or inorganic flocculants or filtering agents are used for conditioning. For example, if use of an organic flocculant in a centrifuge is followed by a fluidized bed furnace, the costs for the mechanical dewatering stage increase, due to rising flocculant consumption. The decrease of the incineration costs slows down with increasing flocculant consumption. A low cost minimum is obtained at a specific flocculant consumption of 2.9 g/kg dry substance. For the vacuum filter and the filter press no cost minimums exist. The lowest costs are obtained when the minimum filtering agent is required to remove the cake from the filter cloth or the filter press is added.

*Sludge treatment, *Dewatering, Operating costs, Capital costs, Centrifugation, Filters

Vacuum filters, Band press

J082
OCCURENCE OF PESTICIDES IN SELECTED WATER SOURCES IN ISRAEL,

Kahanovitch, Y., and Lahav, N.

Tahal, Water Planning for Israel, Tel-Aviv, Israel

Environmental Science and Technology, Vol. 8, No. 8, p 762-765, August, 1974. 1 fig, 3 tab, 8 ref.

A determination was made of 12 organic pesticides in selected water samples in Israel between 1972-1973. Concentrations of the pesticides were discovered to be much lower than the permissible levels; being on the order of a few nanograms per liter. Samples containing no pesticides were taken from the Dan River and drainage water from agricultural fields. The most common compounds found in the water samples being analyzed were gamma BHC and alpha-BHC. A large concentration of BHC found in municipal sewage suggests that it is an important source of BHC in the investigated water bodies. Lake Kinneret's and other reservoirs' low and consistent levels of pesticide content is apparently the result of buffering action of the bottom sediment.

*Pesticides, *Water pollution, *Sewage, *Sampling, Lakes, Reservoirs, Effluents

*Lake Kinneret, *Dan River, Chlorinated hydrocarbons, BHC, Israel

J083
MILESTONE WATER LEGISLATION ACCOMPANIED BY MILLSTONE OF BUREAUCRATIC RED TAPE,

Cox, W. A.

Hampton Roads, Virginia, Sanitary District

Professional Engineer, Vol. 44, No. 10, p 21-23, October, 1974.

Since the passing of Public Law 92-500, water quality planning has been improved. However, the processes and steps required to activate a new major waste treatment facility are time-consuming and costly. Uniform effluent limitations to meet 1977 and 1983 treatment method deadlines impose a great deal of pressure on municipalities, especially on their consulting engineers. Applications for funding are processed slowly at the Federal level; Congress has also impounded many of the existing funds. It was recommended that modifications be made either in the law or in the implementation of regulations to ease some of the burden. These include: modification of the time frame constrainst; release of impounded funds to stimulate new jobs and manufacturing; reduction of the Federal percentage of participation in funding water pollution control projects; streamlining of the fund distribution process; and, the reinstatement of provisions for reimbursement to municipalities. In addition, it was suggested that more responsibility be delegated to the states, that fund allocation to the states be resumed on a population basis, and that the requirements for user charges be amended to allow localities and regional agencies to employ the types of financial procedures used under state laws and municipal ordinances. Finally, one should establish a continuing review of required treatment standards so that they remain flexible to consider demands of the nation's critical energy supply, operating and capital costs, and effects of treatment on receiving waters.

*Water quality planning, *Legislation, *Federal jurisdiction, Effluents, Water pollution control, Treatment facilities, Regulations, Waste treatment, Participating funds, Costs

*Public law 92-500

J084
RENOVATED WASTE WATER: THE QUESTION OF PUBLIC ACCEPTANCE,

Sims, J. H., and Baumann, D. D.

George Williams College,
Downers Grove, Illinois, Department of Counseling Psychology

Water Resources Research, Vol. 10, No. 4, p 659-665, August, 1974. 2 fig, 6 tab, 15 ref.

Among the new alternatives for sources of water supply is the utilization of renovated waste water. Public reaction to such a method presents a problem because of two basic factors. One is that the general public has had no previous experience with direct recycled water, and the second being the psychological distaste for reused water. A study was conducted with three goals: the identification of the nature and frequency of public responses to the concept of recycled water according to its varied uses; the determination of how these responses relate to the standard sociological characteristics of the sample class which has previously been determined relevant; and an attempt to explore psychological variables thought to influence acceptance or rejection of the use of recycled water. A pilot study questionnaire was administered to 220 people in four communities in six different states. A sample included variations in social background such as age, sex, education, and profession. In a comparison of two groups with polar views on the question of whether or not they would drink reused water, it was discovered that they differed in the predicted direction in the completions to 10 of the 29 sentence items. Four of the ten items related to the psychological dread of contact with the impure. A more comprehensive investigation based on the pilot study findings was administered to 400 people in five communities in four states.

*Water reuse, *Waste water treatment, *Water pollution, *Psychological aspects, *Human behavior, *Social aspects

J085
DESIGN CONSIDERATIONS--WATER AND EFFLUENT DISPOSAL,

Brand, W. E.

Ames Crosta Milk Company, Limited

Institute of Food Science and Technology, Vol. 7, No. 2, p 130-137, June, 1974.

A Sewerage Bill was introduced into Parliament in 1968, with Part II of the bill concerning trade effluent in accordance with the recommendations of the Hill Watson Committee. According to this act, the local authority is compelled to "provide public sewers to effectively drain their area domestic sewage, surface water and trade effluent and also provide sewage treatment works to effectively deal with the contents of the sewers". The local authority has jurisdiction over conditions relating to the sewers into which trade effluent may be discharged; the nature and composition of all trade effluent, maximum quantity and hourly rate, the prohibition of any constituent of any trade effluent which may be detrimental to the operation of the sewers, and the provision of inspection chambers. In regard to water quality control, bacteriological quality, suspended matter, organic matter, dissolved gases and dissolved solids are the salient headings. Effluent standards are dependent upon the place of the trade effluent discharge. Standards applied to effluents being discharged into rivers are much more strict than the normal limit of less than 20 ppm BOD and 30 ppm suspended solids. More stringent pH and temperature limits are also enforced. Regulations of discharge to tidal waters would be less strict than discharge to a river.

*Effluent control, *Sewers, *Water pollution, *Sludge disposal, Industrial pollution, Rivers, Surface water, Water quality management, Waste water treatment, Activated sludge, Domestic sewage

*The Sewerage Bill of 1968 (Scotland)

J086
COST EVALUATION OF WATERCOURSE MANAGEMENT IN ESSEX,

Brooker, M. P., and Baird, J. H.

Cambridge University,
Department of Applied Biology

Surveyor Public Authority Technology, No. 4288, p 34-37, August 16, 1974. 2 fig, 2 tab, 2 ref.

In England and Wales about 3 million acres of agricultural land are entirely dependent on drainage systems of dykes and larger channels and an additional 2 million acres on wet ditches. The maintenance of good drainage by keeping the watercourses free of vegetation is of national importance. In the past, clearing of the channels has been by "brushing" or cutting and subsequently removing vegetation from the channel by hand. However, chemical control such as the use of herbicides is becoming a more desired solution to this problem. Detailed records have been kept which allow a direct comparison of the unit costs of chemical applications and conventional hand clearance; the unit cost per annum of herbicide treatment is about 50-75% of the conventional hand clearance, raking and disposal. Other factors than cost are involved in the choice of whether to use chemical control. The most important are the implications of using water containing herbicides for potable and agricultural purposes and the ecological effects of their use. The dosages used in chemical control are unlikely to produce acute toxic effects in man or livestock. One problem involved with using herbicide containing water for public water supply is the presence of tastes and odors. If recommendations for use are followed correctly, herbicides such as 2,4-D and dalapon are unlikely to affect crops irrigated with treated drainage water. The ecological effects on birds by destroying their nesting places and the change in the benthic invertebrates which may in turn cause a change in fish populations and the effects of chronic doses of herbicides on human and farmstock populations must be evaluated before widespread use of chemical control for watercourse management can be instituted.

*Watercourses (legal aspects), *Drainage systems, *Herbicides, *Environmental effects

J087
PUBLIC ACCEPTANCE OF RENOVATED WASTE WATER: MYTH AND REALITY,

Baumann, D. D., and Kasperson, R. E.

Southern Illinois University, Carbondale, Illinois,
Department of Geography

Water Resources Research, Vol. 10, No. 4, p 667-674, August, 1974. 3 fig, 3 tab, 36 ref.

The rapidly increasing water withdrawals in the United States have forced the nation to consider waste water treatment renovation as a viable alternative. The U.S. Federal Water Resources Council (1968) has determined that the "large withdrawals estimated in relation to runoff indicate that even with increased in-plant recycling a large increase in reuse of waste water would be required." Waste water renovation by municipalities would serve to alleviate water shortages, at the same time improving the quality of our streams. An investigation of the feasibility of a 100 mgd waste water purification plant using the effluent product of a secondary treatment plant estimated that drinking water could be produced for about 16 cents/1000 gallons. The delay in acceptance of chlorination is attributable, not merely to cost or questionable effectiveness, but to various social and political obstacles in a community. A review of surveys conducted indicates that consulting engineers and public officials are less enthusiastic about water reuse for the reason of public distrust of such a process. In the attempt to gain public acceptance of high-order use of recycled water there are no examples of community acceptance or rejection available for analysis. Examples of low-order uses are varied; golf course irrigation, industrial cooling and boiler feed, and irrigation being among them. The evidence indicates that education and exposure to waste water reuse can arouse public support of such methods.

*Water reuse, *Waste water treatment, *Water pollution, *Human behavior, *Surveys, Desalination, Chlorination

*U.S. Federal Water Resources Council, United States Office of Water Research

J088
PLANNED REUSE OF POLLUTED WATER AND WASTEWATERS,

Okun, D. A.

North Carolina University, Chapel Hill, North Carolina

Effluent and Water Treatment Journal, Vol. 14, No. 7, p 373-376, July, 1974. 11 ref.

The indirect reuse of waste waters for municipal supplies can create serious problems when poorly planned. A malfunctioning water treatment facility can carry contaminated water to great numbers of the population. When raw waters are polluted, treatment facilities require a well designed and operated scheme, with qualified chemists and bacteriologists supervising operations at all times. Conventional treatment is not absolute protection against the spread of viruses, including infectious hepatitis. The presence of chemical compounds poses a threat to the population, since conventional water treatment is only partially effective in removing carcinogenic and genetically damaging chemicals. For the reuse of water for potable service, the hazards increase. An adequate technology for analysis and monitoring of potable waters is not available to prevent contaminated supplies consumption. Reclaimed waste water can effectively be used for non-potable purposes, relieving the pressure on limited high-quality water sources. The cost for water reclamation is far less than that required for developing high-quality freshwater sources. The burden on receiving bodies of waters is greatly diminished. The American Water Works Association has indicated that the use of reclaimed waste is beneficial in applications such as industrial cooling and processing, irrigation of crops, recreation, and groundwater recharge.

*Water reuse, *Potable water, *Waste water treatment, *Public health, Industrial pollution, Chemical pollution, Viruses, Bacteriology

*American Water Works Association, *World Health Organization, *United Nations Economic and Social Council

J089
INDUCED INFILTRATION SUPPLY SYSTEM AMONG BIGGEST,

Water and Pollution Control, Vol. 112, No. 9, p 33, 38-39, September, 1974. 2 fig.

An induced infiltration supply system including pump house for a water supply system has recently been installed for the City of Prince George, British Columbia. The system cost around $1.2 million which was a 44% saving over the estimated cost of a river intake and treatment plant. In addition to the capital cost saving, there will be annual operating cost savings in the form of chemical treatment, operation and maintenance costs associated with surface water treatment plants. The completed project includes a Fehlmann collector, one of the highest capacity ground water collectors in the world. An investigation was done to determine the best method of supplying water which included drilling and logging test wells, constructing temporary pumped wells, and aquifer testing an an extensive glacial outwash area along the Nechako River. The Fehlmann collector is guaranteed to produce a minimum of 10 mgd up to a maximum of 15 mgd. The collector consists of a 16 ft inside diameter caisson of reinforced 4000 psi high early strength concrete with 1.5 ft thick walls and a bottom of 6 ft thick reinforced concrete. Other specifications and details of construction and operation are given.

*Water supply, *Aquifers, *Infiltration, *Water resources, Pumps, Costs, Canada, Water treatment, Facilities, Construction

*Fehlmann collector, *Induced infiltration

J090
ILLINOIS LANDFILL LAW MAY EFFECT NEARBY STATES,

Solid Wastes Management, Vol. 17, No. 8, p 36, 46, 58, 72, 78-79, August, 1974.

The Pollution Control Board of Illinois has developed a broad-based policy on the control of landfill operations. The key provision states that no person in any state may allow a sanitary site to be maintained so as to threaten or permit the discharge or emission of pollutants into the environment so that they may in any way contaminate the air and/or water within the state of Illinois. This means that any individual or organization that is in violation of the law is liable for his act even though the initial polluting may have occurred outside of the state of Illinois. An outline of the legislation is presented. Subjects covered include permits, methods of operation, type of wastes that may be deposited, features that must be included in a landfill site, and items that must be contained in an application for a landfill permit. Development permits are required for the development of any new solid wastes management site or for the modification of an existing site. Operating permits are required to operate a site. Experimental permits will be issued for methods that do not satisfy the current standards if the applicant can show proof that the method has a reasonable chance for success and that there are minimal environmental hazards.

*Landfills, *Solid wastes, *Waste disposal, *Legislation, Illinois, Regulation, Permits, Environmental sanitation, Water pollution sources

J091
FRESHWATER ECOSYSTEM RESEARCH IN WATER QUALITY MANAGEMENT,

Ferris, J., Clesceri, N. L., and Auerbach, S. I.

Rensselaer Fresh Water Institute, Lake George,
New York

Environmental Science and Technology, Vol. 8, No. 8, p 706-710, August, 1974. 3 fig, 2 tab, 5 ref.

Teams of U.S. scientists from many disciplines combined to study total ecosystems in the U.S. The International Biological Program was created to help define the biological basis of productivity for human welfare, investigating organic production on land, in fresh waters, and in seas, potentialities and uses of new natural resources, and human adaptability to a changing environment. A common goal was the achievement of information that would lead to rational resource management for fresh water ecosystems. The ability of proper assessment was founded on a simplified method, and the predictability of changes in the conditions and dynamics of ecosystems was demonstrated by ecosystem modeling. More than 80 lakes were studied. The U.S. was integrated into biomes of living organisms, with each community exhibiting its own scientific similarity. The Tundra Biome concentrated on natural and exogenously disturbed ecosystems in the wet Arctic tundra. The Desert Biome investigated abiotic and biotic systems and built question-oriented submodels describing a series of relationships allied to organism function within the ecosystem. The Coniferous Forest Biome assessed forest and urban land-use influences, energy sources for aquatic food chains, and the structure and metabolism of communities and their nutrient budgets. The Eastern Deciduous Forest Biome concentrated on the IBP goal of better ecosystem understanding and the prediction of results from changes induced by man.

*Water quality management, *Biomes, *Freshwater, *Ecosystems, Lakes, Reservoirs, Forests, Deserts, Environmental control, Fish, Aquatic life

*International Council for Scientific Unions, *Special Committee for the International Biological Program

J092
BIOLOGICAL CONTROL: ISOLATION AND BACTERIAL OXIDATION OF THE TASTE-AND-ODOR COMPOUND GEOSMIN,

Narayan, L. V., and Nunez, W. J.

Detroit University, Detroit, Michigan

Journal of the American Water Works Association, Vol. 66, No. 9, p 532-536, September, 1974. 6 fig, 2 tab, 13 ref.

A variety of microorganisms have been cited as the causes of naturally occurring tastes and odors in water supplies. The two most important of these microbial odor causing compounds are mucidione and geosmin. The isolation of geosmin from Anabaena circinalis, determination of the threshold odor level, enrichment culturing of microorganisms, cell cultivation and collection, and oxidative degradation were studied. Geosmin was found to be the primary odor component in Anabaena circinalis. The distillation and extraction of the entire algal culture of Anabaena circinalis, cells and medium, yielded more geosmin than distilling the algal cells alone. The geosmin in the medium was probably the result of a release of metabolites during physiological transitions of the algal culture. Manometric oxidation studies were found to be useful for scanning microorganisms as agents for controlling taste and odor compounds in water. Sarcina sp., Micrococcus sp., Mima sp., Escherichia coli, Alcaligenes viscolactis, and Bacillus sp. were all examined in regard to their ability to degrade geosmin. Bacillus sp. appeared to be the best bacterial organisms for biological control of odor causing metabolites. Bacillus cereus strain 10876 has previously been reported as the best strain of bacteria for the degradation of geosmin. However, Bacillus subtilis strains and Bacillus cereus strain ATCC 9139 proved to be as effective as Bacillus cereus strain 10876 in degrading geosmin.

*Biodegradation, *Odor-producing algae, *Odor, *Bacteria, Taste, Water quality, Biological treatment, Biocontrol, Microbial degradation

Bacillus sp., Geosmin, Anabaena circinalis

7666

J093
HOW TO ESTIMATE AND ESCALATE COSTS OF WASTEWATER EQUIPMENT,

Blecker, H. G., Epstein, H. S., and Nichols, T. M.

Icarus Corporation, Silver Spring, Maryland

Chemical Engineering, Vol. 81, No. 22, p 115-121, October, 1974. 13 fig, 2 tab.

Charts and tables of cost data are presented to aid in the preparation of conceptual or rough estimates of the cost of facilities for treating waste water, or comparing alternative processing schemes. A technique for escalating the estimate to a future time is also described. The cost data were generated as a computer-aided design and estimating system which determines equipment costs in the same way as an equipment vendor and assembles the complete installed costs the same way a contractor does at the definitive stage. Graphs are included giving the purchased-equipment costs (or field-erected cost), equipment-setting manhours, installed-equipment cost, total field-labor manhours, and the labor-to-material ratio. An example of how to determine the escalation of cost is given. To determine the total installed cost for the equipment item in a South Philadelphia treatment plant in the 2nd quarter 1976, the estimated purchased-equipment cost for the 2nd quarter 1975, the material cost (less equipment) for 2nd quarter 1975 and the field-labor cost for 2nd quarter 1976 must all be calculated. The graphs cover such equipment as storage vessels, vertical pressure vessels, field labor for vertical pressure vessels, general-service centrifugal pumps, reinforced concrete aeration basins, motor-driven reciprocating pumps, motor-driven rotary blowers, variable speed motors and rectangular excavations.

*Waste water treatment, *Costs, *Equipment, *Facilities, Computer programs, Engineering, Design, Installation, Water works, Alternative costs, Capital costs, Construction costs, Installation costs, Initial costs, Real costs

J094
CITY/TOWNSHIP JOINT VENTURE--A NEW WATER PLANT,

Kyes, W. K.

East Lansing-Meridian Water and Sewer Authority, East Lansing, Michigan

Water and Sewage Works, Vol. 232, No. 8, p 88-91, August, 1974. 3 fig.

The East Lansing-Meridian Water and Sewer Authority was formed in 1969 to provide a sufficient quantity of fully treated water to the City of East Lansing and adjoining Meridian Township. A water treatment plant was put in operation in 1973 which provides 15 mgd of water containing 85 mg/liter or less of hardness and no iron. The plant incorporates an in-house lime handling system to transfer the pebble lime from large storage bins to day bins positioned over the lime feeders. Pretreatment is provided in two primary clarifiers and two secondary clarifiers. Mixing, flocculation and sedimentation are performed in one tank. Wood plank deck and laminate wood beams were chosen to cover the pretreatment tanks because of the lower capital cost than that of a concrete roof and the lack of future maintenance requirements. A concrete roof would have cost more and required periodic painting. After pre-treatment, the water is applied to dual media (sand covered by anthracite) gravity sand filters for removal of chemical floc. Lime soda softening of the water results in two waste by-products: the backwash water is stored in an earthen pond and recycled to the inlet of the plant; the lime sludge is stored in a lagoon system where the solids settle out and the clear supernatant left is collected and pumped back to the plant. The plant functions with semi-automatic controls. Sixteen new wells, more than 9 miles of pipe to transport the water to the plant and 2 miles of distribution mains were developed in conjunction with the water treatment plant.

*Water treatment, *Water supply, *Domestic water, *Facilities, Water softening, Hardness (Water), Water purification, Water wells, Filters

J095
HOW SILICA AFFECTS IRON REMOVAL FROM GROUNDWATER,

Robinson, L. R., Jr.

Environmental Engineering Division, Yule, Jordan and Associates, Camp Hill, Pennsylvania

Water and Sewage Works, Vol. 122, No. 3, p 74-77, March, 1975. 9 tab, 18 ref.

Interference with iron oxidation and removal is frequently attributed to low pH and low alkalinity concentrations. It has also been indicated that high concentrations of silica can catalyze ferrous iron oxidation and retard hydrolysis of ferric iron and thus hinder sedimentation and filtration. The results of both jar tests and pilot plant studies indicate that silica interference with iron removal is apparently the reaction of silica in alkalinity determinations to indicate sufficiently high bicarbonate alkalinity to insure rapid ferrous iron oxidation. When lime or soda ash were added, satisfactory iron oxidation and removal was achieved. These results confirm the hypothesis that a bicarbonate alkalinity of at least 100 mg/liter as CaCO3 is necessary to obtain immediate oxidation and subsequent removal of iron from groundwater. Tests were performed on several groundwater supplies in East Pakistan where poor iron removal was obtained even though alkalinities were found to be in excess of 100 mg/liter. Silica was observed in significant concentration in several of the waters studied. Where treatability was unsatisfactory, the addition of lime or soda ash was successful in causing the oxidation of the iron. The addition of silica in the form of sodium metasilicate had no effect on the treatability of the water.

*Groundwater, *Water treatment, *Iron, *Oxidation, *Silica, Hydrogen ion concentration, Alkalinity, Pilot plants, Laboratory tests

Iron removal

J096
COULD THE SEA BE USED TO STORE WATER FOR SUPPLY?--A POSSIBLE SCHEME,

Mortimer, C. H.

Water Services, Vol. 29, No. 949, p 98-103, March, 1975. 6 fig, 1 tab, 5 ref.

Due to the objections of an environmentally conscious public to the construction of large inland water reservoirs, a water storage scheme is proposed which may resolve this problem and could also make more efficient use of the rivers as sources of water supply. This system involves taking water from a river above the tidal limit and pumping it to a flow balancing tank located on the coast. Two pipes are connected into this tank, one carrying water to a supply and the other leading to the flexible bags situated on the seabed a few miles offshore. The works have been divided into three parts: works at the river abstraction point (including the initial water treatment); the flow balancing tank; and, the bags. The advantages of an undersea storage scheme include: since no countryside is lost through flooding, undersea storage should be more readily acceptable to the general public; it allows a more efficient use of rivers as sources of water supply than at present; some degree of economic flexibility is inherent since by adding more bags to the system the yield can be increased to meet demand; and there are a large number of possible sites around the coastline of Great Britain conveniently close to cities such as Teesside, Newcastle, London, and Hull. The main disadvantage is that underwater storage has a greater chance of an accident occurring which will cause a failure of supply than does inland storage.

*Reservoirs, *Reservoir sites, *Water storage, Reservoir storage, Water supply, Storage capacity, Routing, Dependable supply

*Undersea water storage

J097
DIVISION S-6--SOIL AND WATER MANAGEMENT AND CONSERVATION,

Kelling, K. A., and Peterson, A. E.

Ball State University,
Muncie, Indiana,
Department of Natural Resources

Soil Science Society of America Proceedings, Vol. 39, No. 2, p 348-352, March/April, 1975. 1 fig, 4 tab, 25 ref.

When agricultural land and forests are converted to urban uses, major effects on area water relationships can occur. With urbanization there is a tendency for larger amounts of surface runoff due to more impermeable surfaces, disturbances to the natural soil profile, and greater compaction. Infiltration runoff measurements were made on nine urban lawns using a sprinkling infiltrometer in conjunction with the application of a complete fertilizer at three rates. The amounts of inorganic N, P, and K removed with the runoff water were determined. Results of infiltration measurements showed that the presence of textural and compaction discontinuities within the soil profile, formed during building and lawn construction, was probably the greatest factor affecting infiltration. A second order equation best described the relationship between percent of applied fertilizer in the runoff and 90-minute cumulative infiltration.

*Infiltration, *Infiltration rates, *Water management (applied), *Urbanization, Runoff, Fertilizer, Soil management, Equations

J098
YWA PLANS FOR CLEANER RIVERS,

Appleton, B.

New Civil Engineer, p 21-22, January 23, 1975

The Yorkshire Water Authority, Great Britain, has developed plans for water pollution control of its two major rivers. Sources of pollution are both industrial and municipal. One problem is overflow from sewers during storms. Where the capacity of a sewer has been reduced to below twice dry weather flow, serious surcharging occurs during storms, causing pressure buildup so that manhole covers are blown off and sewage flows out of these openings. Infiltration from surrounding groundwater adds to normal surface runoff and thus further reduces the amount of foul sewage retained in the sewer. When the Rother river level rises, discharges from sewage overflows is shut off and sewage flows into the river as the storm abates and river flow drops. Plans include building of new interceptor sewers to pick up sewage from existing and new branch sewers and to carry up to 50 cu m/sec to a low level pumping station. Another development is a trunk sewer to relieve parts of the city. Besides sewerage problems, the area rivers are polluted from mine drainage. Treatment requires aeration for complete oxidation followed by settlement of the ochre. Other plans include an investigation of the possibility of mixing industrial effluents with domestic sewage for treatment at the local sewage plant.

*Water pollution control, *Rivers, *Waste water treatment, Water pollution sources, Storm runoff, Sewage treatment, Sewerage, Overflow, Planning, Industrial wastes

Yorkshire River Authority

J099
PREVENTING BACKFLOW IN PIPING CROSS CONNECTIONS,

Keegan, J. F.

Watts Regulator Company,
Lawrence, Massachusetts

Plant Engineering, Vol. 29, No. 8, p 229-231, April 17, 1975. 6 fig, 2 tab.

Inadvertent contamination of potable water supplies may be avoided by preventing backflow in piping cross connections. Two types of uncontrolled cross connections which permit unwanted reverse flow are back siphonage and backpressure. Siphonage occurs when a water supply system is subjected to an unexpected pressure drop. Backflow from backpressure results when a system component such as a pump or a boiler under pressure produces a pressure exceeding that of the water supply main. In some cases, a combination of back siphonage and backpressure cause backflow. To overcome the possibility of contamination by backflow, in-plant cross connection control programs should be implemented. Backflow prevention devices are described. These cross connections are either the inlet type or the pressure type. In the inlet type, the connection is used for filling a receptacle open to the atmosphere while in the pressure type, water supply is connected to another line or to a pressurized vessel. In the latter, connections are often fitted with shutoff or check valves to isolate nonpotable systems from the potable supply. Selection of the proper prevention device depends upon the type of cross connection to be connected and the degree of hazard existing.

*Water pollution, *Potable water, Pipes, Water supply

Cross connections, Piping, Backflow

J100
STABILITY OF NITROSAMINES IN SAMPLES OF LAKE WATER, SOIL, AND SEWAGE,

Tate, R. L., III, and Alexander, M.

Cornell University, Ithaca, New York, Department of Agronomy,
Laboratory of Soil Microbiology

Journal of the National Cancer Institute, Vol. 54, No. 2, p 327-330, February, 1975. 5 fig, 17 ref.

Interest in nitrosames is prompted because of their possible carcinogenic, teratogenic, and mutagenic properties. Their possible synthesis in fresh waters, polluted waters, and soil is of some concern because the precursors are widespread. The significance of the formation of N-nitroso compounds depends upon the stability of these carcinogens in natural systems and their possible entry into public water supplies, fish, and edible plants. This study assessed the stability of simple nitrosamines (N-nitrosodimethylamine, N-nitrosodiethylamine, and N-nitrosadi-n-propylamine) in lake water, soil, and sewage. No degradation of these nitrosamines was observed in lake water during a 3.5 month period. A slow disappearance was noted in soil after a lag of several weeks. The loss was more rapid in sewage, but even after two weeks more than half of the nitrosamine remained. The results of the experiments on sewage and soil suggest a microbial involvement in the slow decomposition of the nitrosamines.

*Nitrogen compounds, *Soil environment, *Sewage, *Lakes, Water pollution sources, Microbial degradation, Persistance, Pollutant identification, Laboratory tests, Testing, Public health

*Nitrosamines, *Carcinogens

J101
SOME OBSERVATIONS ON BEHAVIOR OF THE TREATED SEWAGE DISPOSED IN THE SEA,

Inaba, D., Arazaki, S., Murooka, H., Deguchi, Y., and Kadota, S.

Nihon University, Japan,
Department of Fisheries, College of Agriculture and Veterinary Medicine

Bulletin of the College of Agriculture and Veterinary Medicine, Nihon University, No. 31, p 54-78, 1974. 15 fig, 8 tab, 4 ref.

A survey of marine disposal of sludge from sewage treatment was conducted in Japan, in order to obtain information on dispersal characteristics in the ocean and to detect effects of this disposal method on water quality and marine life. Color differentiation between sludge water surface and clean water areas was observed just after introduction of the sludge. Vertical sedimentation rate was measured by optical monitoring through marine television, echo sounder devices, and an underwater illuminometer. Particles precipitated into the water at different rates of descent due to specific gravity and differences in particle shape. Water quality analysis was done in relation to ammonia density, BOD, and pH parameters, indicating that these factors did not cause any significant qualitative changes to the environment. Strong winds and high waves provided a rapid dispersal and mixing of the sludge in the aquatic environment. These rapid mixing and dispersal factors are also illustrated by an unexpectedly low general and coliform bacteria count. Further investigations are necessary for more definitive conclusions.

*Sludge disposal, *Oceans, *Environmental effects, Marine animals, Analytical techniques, Sewage treatment, Monitoring, Pollutant identification, Water quality control, Ultimate disposal

Pollutant dispersal

J102
DRUG RESISTANT COLIFORMS CALL FOR RE-EVALUATION OF WATER QUALITY STANDARDS,

Grabow, W. O. K., Prozesky, O. W., and Smith, L. S.

National Institute for Water Research, CSIR, Pretoria, South Africa

Water Pollution Control, Vol 74, No. 2, p 217-224, 1975. 1 tab, 120 ref.

Evidence is presented to support the idea that water polluted with coliform and other bacteria generally considered as non-pathogenic contributes to the incidence of drug resistance among bacteria involved in disease. Resistance to drugs is imparted by chromosomal resistance and by resistance (R) factors. R factors are extrachromosomal nucleic acid elements (plasmids) which replicate autonomously. R factors are transmissible among Gram negative bacteria such as enterobacteria including E. coli, Salmonella typhi and Shigella dysenteriae. Ingestion of bacteria carrying R factors (R+ bacteria) can result in the transfer of these factors to the normal intestinal flora. These organisms then act as a reservoir of resistance which they may transfer to sensitive bacteria involved in disease. The two factors which are involved in the spread of R+ bacteria are drug resistance which selects for resistance plasmids and the transmission of these organisms from excretors to the rest of the population through sewage. Two percent of the coliforms in sewage and in sewage polluted water can be expected to carry R factors (maximum 26% in a hospital effluent). Current water quality standards regard coliforms as purely indicators of fecal pollution. However, since plasmid infected coliforms have been shown to be joined with bacteria increasingly involved in disease, they can no longer be regarded as harmless. This necessitates a re-evaluation of quantitative and qualitative water criteria as well as increasing the list of reasons for more advanced sewage treatment.

*Coliforms, *Sewage bacteria, Pathogenic bacteria, Water quality standards, Sewage treatment, Enteric bacteria, Public health, E. coli, Water pollution sources

*Drug resistant bacteria

J103
SOUTH AFRICAN EUTROPHICATION PROBLEMS: A PERSPECTIVE,

Toerien, D. F.

National Institute for Water Research, Council for Scientific and Industrial Research, Pretoria, South Africa

Water Pollution Control, Vol. 74, No. 2, p 134-142. 1975. 2 fig, 7 tab.

The problem of eutrophication in South Africa is discussed in terms of the nature and prevention of the problem, the restoration of eutrophic impoundments, present and future levels of eutrophication in South African waters, and a comparison of two South African impoundments. The following conclusions were made: eutrophication is a danger to the water quality of South African impoundments; the extent of this danger must be determined; most impoundments in South Africa are still oligotrophic; the eutrophic impoundments are those which receive effluents from urban-industrial complexes; phosphorus is presently the most important algal growth-limiting nutrient; oligotrophic conditions were found to exist below 30 microg-P/liter and eutrophic conditions above 75 microg-P/liter; the range of eutrophication problems already experienced include problems in water treatment, aesthetics, recreation, water weeds, livestock losses, tastes, and odors; the population and per capita water consumption increases expected will lead to more effluents reaching impoundments and to more eutrophication problems unless corrective measures are taken; eutrophication problems have a complex nature and their control is intimately associated with nutrient addition and economics; prevention of eutrophication problems can only be effected through the prevention of enrichment; successful prevention requires detailed knowledge of the specific impoundments under consideration; and, decisions to restore eutrophic lakes depend on many factors such as the uses of the water and the financial implication of restoration techniques.

*Eutrophication, Water pollution Sources, Nutrient removal, Municipal wastes, Phosphorus, Aquatic algae, Oligotrophy, Nutrients, Industrial wastes

South Africa

J104
ENVIRONMENTAL VALUES AND WATER QUALITY PLANNING,

Richerson, P., and Johnston, R.

California University, Davis,
California,
Division of Environmental Studies

Journal of the Hydraulics Division, ASCE, Vol. 101, No. HY2, p 259-276, February, 1975. 2 fig, 59 ref.

A review of problems encountered in water quality planning and various policy decisions to cope with these is given. Objectives of planners include incorporation of the protection of wilderness and the recreational use of water bodies into health and economic aspects of water resources use. A research project has been designed to understand present practices used by three planning agencies. These are the United States Department of the Interior, Bureau of Land Management (BLM), the California State Water Resources Control Board (SWRCB), and the United States Army Corps of Engineers (ACE). The BLM is a multipurpose land management agency, emphasizing environmental protection and economic development. The SWRCB is a limited purpose water management agency, with emphasis on regional protection. The ACE is a limited purpose water development agency committed to regional economics values. An investigation of these agencies discusses planning an adaptive process as it deviates from the traditional rational planning model of problem identification, alternative formation, alternative evaluation, implementation, and review. It was concluded that flexible short-range and contingency-oriented approaches are more successful planning methods than ideal long-term planning. It is recommended that planning systems be improved by careful empirical research of individual problems.

*Water resources development, *Administration, Water management (applied), Economics, Water utilization, Environmental effects, Planning

J105
HYDROGEOLOGY AND WATER QUALITY MANAGEMENT,

Landon, R. A.

Moody and Associates, Incorporated,
Harrisburg, Pennsylvania,
Environmental Services Division

Journal of the Hydraulics Division, ASCE, Vol. 101, No. HY2, p 285-289, February, 1975.

The Pennsylvania Comprehensive Water Quality Management Planning (COWAMP) program has defined and evaluated a hydrogeological framework controlling the occurence and movement of surface and groundwater. This framework involves the natural physical system comprised of the three dimensional arrangement of soils, topography, and geology. Complex interrelationships between groundwater and surface water are not well understood. However, water quality management alternatives must be dependent upon land uses which affect groundwater quality. These include municipal and industrial uses such as aquifer development. Methodology for hydrogeologic evaluation consists of broad-based data acquisition, compilation, and evaluation, followed by the interfacing of hydrogeological parameters, largely as multiple components, with engineering and socioeconomic parameters to select water resources development alternatives.

*Hydrogeology, *Water management (applied), Water resources development, Water utilization, Groundwater, Surface water, Data processing, Data collections, Pennsylvania

Comprehensive Water Quality

J106
PUMP SELECTION,

Walker, R.

Associated Engineering Services Limited,
Vancouver, British Columbia, Canada

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, Vancouver, British Columbia, p 41-56. 7 fig, 5 ref.

Since pumping water and waste water adds only to the cost and not to the value of a product, it is imperative that the pumping cost should be as low as possible. The four major factors in the cost structure of pumping are installed cost-amortization, power or fuel costs, supervision and maintenance, and, the cost of down time and standby equipment. In comparison to the overall cost of the entire installation the actual cost of the pumps and motors is a relatively small item. It is better to buy equipment which may not be the cheapest but which will cost less in terms of fewer repairs and less maintenance. Future expectations of rising fuel costs necessitate that good system design be implemented to insure that the best possible use is made of the purchased energy. Down time of the system can be minimized with the installation of three pumps rather than the conventional two (one pump running, one down for maintenance, and the third unit in standby in case the operating unit fails). Well pumps can either be vertical turbines or submersible pumps. If vertical turbine pumps are to be used, then a profile should be made of each well upon completion. The traditional booster pumps are horizontal, double suction closed impeller centrifugal pumps. The shaft diameter and the distance from center to center of the bearing pedestals are the parameters to consider when choosing these pumps. The selection of the appropriate pumps for sewage transport is also discussed, as well as the various makes of comminutors and self cleaning bar screens that have been designed to aid in sewage transport.

*Pumps, *Waste water treatment, *Sewage treatment, *Equipment, *Costs, Sewerage, Pumping

J107
WATER RESOURCES,

Marr, B. E.

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, Vancouver, British Columbia, p 1-10.

The functions and responsibilities of the British Columbia Water Resources Service include water licensing, water investigations (engineering and planning), pollution control, and environmental matters. The pollution control and environmental activities of the Water Resources Service are discussed. A series of public inquiries into each of the major categories of waste discharge in B. C. were held beginning in 1970. Three levels of objectives have been established for most classes of discharge. These objectives will be upgraded or amended to incorporate and reflect changes in technology, economic conditions, and public attitudes. B. C. has developed a discharge permit system. The last five years have seen a good inventory of discharges compiled, objectives set for most types of discharges, and identification of environmental, technical, and administrative problems. A need exists for flexibility in planning--regional, site, resource development, and waste management planning. The structure within the Water Resources Service is being integrated and decentralized. Investigations are being performed to increase the department's expertise in environmental sciences. Waste treatment plant operator training programs are being initiated.

*Planning, *Administration, *Water pollution control, Waste water treatment, Legislation, Water resources, Canada

J108
A NEW LOOK AT POLLUTION PREVENTION ON LOWLAND RIVERS,

Fish, H.

Thames Water Authority, Great Britain

Water, No. 3, p 2-4, April, 1975.

It has been shown in recent years that current pollution control practices will not be adequate for the future protection of public supplies drawn from lowland rivers. This reason has prompted the Thames Water Authority to institute a program for the assessment and control of the extent and nature of continuous contamination of lowland water sources with persistent chemicals. Some of the considerations which have led to this conclusion and new approach include: a recent 3 year dry period which resulted in very high increases in the concentration of residual pollutants, especially nitrates, in river water; the discovery of benthal biomethylation of mercury and bioconcentration and biotranslocation of chemical residues; and, the finding of the transfer of minute herbicide residues from rivers into public water supplies. Basically, the new pollution control approach would put the current system into new overall arrangements to determine, in detail and with all possible accuracy, what chemical contaminants are, or may be, passed into lowland water supply rivers, whether these are likely to present any health hazard in public supplies abstracted from the rivers, and to seek removal or reduction to acceptable levels of all contaminants which are, or are likely to be, dangerous. The new approach can be described as "catchment quality control".

*Water quality control, *Pollution abatement, *Water supply development, Administration, England, Chemical, Water pollution sources, Pesticides, Organic pollutants

J109
THE WATER QUALITY AND BOTTOM SEDIMENT CHARACTERISTICS OF NEW JERSEY LAGOON DEVELOPMENTS,

Thurlow, E. H.

Rutgers University,
New Brunswick, New Jersey

Dissertation Abstracts International B., Vol. 35, No. 10 p 4931, April, 1975.

A three year study of four lagoon developments near Ocean County, New Jersey, was conducted to determine the nature of the water and bottom sediments, and the effects of types of waste disposal systems. It was found that each lagoon development had its own characteristic channel arrangement, amount and type of fresh water input, and inland penetration. Depth was a major factor influencing water quality; depths within and between lagoon systems were variable. Because lagoon areas are usually deeper than the adjacent bay, there was a hindering of water exchange and stagnant conditions are created in the bottom waters. As the shallowest area of the lagoon is usually at the mouth, the deeper remote points tended to be slightly more polluted due to depth, fresh water input, or poor water circulation. NH4(N), NO3(N), NO2(N), PO4, Cl, SO4, and some heavy metals, as well as anaerobic conditions were found accumulated in very deep lagoon areas. Lagoon sediments tended to be high in organic matter, total nitrogen content, CEC, and exchangeable cations, and to be black musks with H2S odors. An increase in population had an adverse effect on both the water quality and bottom sediments through increased addition of pollutants and organic materials from sewage, homes, and boats. Water quality in unsewered lagoons was better than quality of water in sewered lagoons, but bottom sediments of each were similar.

*Waste disposal, *Lagoons, *Sewage, *Water quality control, New Jersey, Heavy metals, Sedimentation

Bottom sediments

J110
A FIELD STUDY OF PHYSICO-CHEMICAL STATES OF ARTIFICIAL RADIONUCLIDES IN SEAWATER,

Nagaya, Y., and Nakamura, K.

National Institute of Radiological Sciences,
Anagawa, Chiba, Japan,
Division of Environmental Contamination

Journal of the Oceanographical Society of Japan, Vol. 30, p 179-184, 1974.
1 fig, 3 tab, 15 ref.

The behavior of artificial radionuclides in seawater has been shown to differ from the behavior of natural isotopes, at least within a duration of time after the artifical substances have been introduced into the sea. The physico-chemical states of artificial radionuclides 90Sr, 137Cs, and 144Ce in seawater were studied by radiochemical analysis of filtered and unfiltered seawater, in order to understand and predict the radioactive contamination of the marine environment. These fallout radionuclides were analyzed, and the difference of radionuclide concentrations between unfiltered and filtered seawater was defined as the particulate form radioisotope. A considerable amount of 144Ce was found to be particulate. Almost no 90Sr greater than 0.22 microns in size was observed in either coastal or open seawaters, but much 137Cs seemed to be insolubic in coastal waters. For the Kashima-nada area, the possible occurence of particulate radionuclides greater than 0.22 microns in size was estimated, and was found to one percent or less for 90Sr and 6 percent for 137Cs. In coastal water, 80 percent of 144Ce were in particulate form, but very little particulate 144Ce was found in the open seawater. The influence of suspended matter to 137Cs and 144Ce concentration levels in seawater is as yet undetermined.

*Radioactive wastes, *Fallout, Filters, Radioisotopes, Oceans, Water pollution, Analytical techniques

J111
WATER QUALITY CONTROL IN SEWAGE WATER TREATMENT,

Fujimoto, E., Sato, N., and Sekine, T.

Meiden Jiho, Vol. 5, No. 118, p 40-48, 1974.

To control the operation of sewage treatment plants, mathematical equations are proposed for individual treatment units, such as the sand-precipitation pond, aeration tank, sterilization pond, sludge concentration bath, and sludge feedback system. The model equations reflect the water qualities at each individual unit as well as quantitative conditions appearing at each unit. The equations are to be used by computers to predict better quality, rather than quantity, control in sewage plants. For example, the equation to control air amounts supplied to aeration tanks is expressed as the function of amount of sewage water, oxygen mobility (which is a function of temperature), oxygen dissolution efficiency, BOD value, MLSS value in aeration tank, and aeration tank capacity. Therefore, to regulate the air amount in the aeration tanks, the measurements of amount of BOD, MLSS values, and dissolved oxygen are all necessary. The use of model equations for computer quality control will be applicable to sewage plants with future developments in sensoring instrumentation.

*Water pollution control, *Waste water treatment, *Sewage treatment, Aeration, Instrumentation, Model studies, Equations, Biochemical oxygen demand

J112
COST SHARING TO HELP CLEAN OUR WATERWAYS,

Dimensions NBS, Vol. 58, No. 12, p 267-269, December, 1974.

The National Bureau of Standards (NBS) was asked to evaluate the Construction Grant Program by the Environmental Protection Agency, a federal cost-sharing program as defined after the Federal Water Pollution Control Act Amendments of 1972. It was decided by two NBS economists that the cost-sharing is not as efficient or as equitable as it could be. Because the Construction Grant Program provides different levels of Federal funding for different techniques and costs, municipalities may be encouraged to build oversized or inappropriate facilities. The Federal Government subsidizes 75% of the capital costs and cost of land that is needed for the treatment process but does not cover operation or maintenance. Any technology which requires a large operation and maintenance rather than capital costs expenditure will receive little Federal assistance. Distribution of benefits is discussed. Without effective regional cost-sharing management, it may be difficult to apportion costs appropriately between the regional and the federal sectors. Current user fees imposed on industry, households, and businesses for sewage removal and treatment contribute to inefficiency in the selection of techniques and the size of newly developed facilities. The existing program also results in a larger Federal subsidy to industrialized communities than to residential communities. It was suggested, that with optimal cost-sharing, municipalities should choose a scale of abatement that is locally and nationally efficient, and then pay a cost share equal to their marginal benefits.

*Costs, *Federal Water Pollution Control Act, *Economics, *Cost sharing, Waste water treatment, Facilities, Federal government, Municipal water, Industrial water

*National Bureau of Standards, Construction Grant Program

J113
OIL SPILL TECHNOLOGY,

Ross, S. L.

Environment Canada, Ottawa, Ontario, Canada,
Environmental Emergency Branch

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, Vancouver, British Columbia, p 125-141. 5 fig, 2 tab.

The Environmental Emergency Branch of Environment Canada was formed to cope with environmental emergencies. To deal effectively with environmental emergencies, the following items must be considered: analysis of the threat; preparedness; and, evaluation of the risk. The state of preparedness is dependent on: the contingency plan which assigns the responsibilities and personnel necessary to reduce the damages due to an emergency; the training of the personnel; and, the availability of proper equipment, techniques and materials. Most of the materials, techniques and equipment currently used are unsatisfactory in terms of their application, labor requirements, sophistication, and/or effectiveness. Research and development requirements in the following areas are representative of the lack of scientific knowledge: diking of storage facilities; detection of spills; containment of spills; recovery of oil and other hazardous materials; and, cleaning and restoration of beaches contaminated with oil. The examples given deal with oil spills but are applicable for other types of environmentally hazardous materials. Guidelines are given for assessing every project for the evaluation and development of new technology.

*Water pollution control, *Oil spills, Environmental control, Environmental engineering, Disasters

Environmental Emergency Branch, Environment Canada

J114
ROLE AND RESPONSIBILITIES OF THE ENVIRONMENTAL PROTECTION SERVICE (CANADA),

Edgeworth, L.

Environmental Protection Service, Ottawa, Ontario,
Canada, Department of the Environment

In: Proceedings of the Annual Conference of British Columbia Water and Waste Association, April 9-11, 1974, Vancouver, British Columbia, p 59-69.

The history and duties of the Environmental Protection Service of Canada are discussed. The EPS is concerned not only with activities that are directly tied to environmental protection but also with the management and improvement of Canada's renewable resources such as fisheries, forestry and wildlife. The Fisheries Act, the Canada Water Act, and the Fisheries Act amendments are some of the legislation that has defined the roles of the federal and local governments and provides for an optimization of benefits through rational resource management. Water pollution control is based on the use of the best practicable technology, meaning that in most cases it does the job in terms of protecting the environment, and also meaning that it does not require the impossible or the economically destructive. The goal of a balanced program is being achieved through a system of cooperation. The EPS has set up a special Environmental Emergency Branch to improve the national ability to deal with environmental accidents such as oil spills. This unit is developing contingency plans for all conceivable problems and is developing a central operations center. Newer legislation is directed toward the control of special types of products which may cause pollution problems such as gasoline additives and phosphate containing detergents. Canada is learning that energy and the environment are not two different disciplines but that the preservation of a clean environment is the result of the knowledgable application of energy through the right sources.

*Water pollution control, *Legislation, *Canada, Environmental control, Administration 777

J115
TENSIDS (SYNDETS) AND THE WATER POLLUTION PROBLEM (GESUNDHEITLICHE ASPEKTE DES TENSID-GEbRAUCHS),

Janicke, I. J.

Fortschritte der Medizin, Vol. 93, No. 8, p 377-378, March, 1975. 4 ref.

Surface active agents in sewage originating mostly from household detergents are an important factor in the determination of environmental influences on man, with special reference to the water supply. The current German legislation on detergents considers the problems in a comprehensive sense including the overall toxicity via and in the water system. The recent literature on toxicological values for warm-blooded animals and aquatic organisms such as sewage degrading bacteria and the influence of chemical structure is discussed. The toxicity of surfactants to a biological sewage treatment system including the effects on anaerobic digestion is considered to be of special importance. Successful control of environmental pollution caused by surfactants in the water can be achieved by the use of adequate sewage treatment.

*Waste water treatment, *Surfactants, *Detergents, Domestic wastes, Sewage treatment, Toxicity, Legislation, Foreign research, Environmental effects, Biological treatment, Anaerobic digestion, Water pollution control

J116
ENDEMIC NEPHROPHATHY AND ITS RELATION TO THE CONTAMINATION OF WELL WATER BY PHENOLIC COMPOUNDS IN BARSA-ARAD (NEFROPATIA ENDEMICA SI RELATIA CU IMPURIFICAREA PRIN COMPOUSI FENOLICI IN APELE FINTINILOR DIN COMUNA BARSA-ARAD),

Mustata, N.

Clujul Medical, Vol. 47, No. 3, p 543-547, 1974. 2 tab, 8 ref.

Phenolic compounds were found in the water of wells in the commune of Barsa-Arad. Eleven persons died after drinking this water and 9 other persons were ill with endemic nephropathy. The concentrations of phenolics varied between 28 and 203 gamma/liter. The concentration levels were found to be distributed in three rows at the base of the ground level elevation existing in this locality to the bank of the Morilor channel. A similarity was determined to exist between the peculiarities of contamination with phenolic compounds in the Barsa-Arad region and of other zones of endemic nephropathy in the Secaseni (Caras-Severin District) and Strehaia (Mehedinti District) of Romania.

*Public health, *Water supply, *Phenols, *Potable water, Wells, Human pathology, Mortality

*Endemic nephropathy

J117
EXTRACTABLE METALS IN MIXTURES OF SOIL AND SEWAGE SLUDGE,

Webber, M. D., and Caynor, J. D.

Agriculture Canada, Soil Research Institute

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 249-266. 6 tab, 12 ref.

There has been evidence primarily from England that the use of sewage sludge on farmland can result in trace metal pollution. In view of this evidence the Soil Research Institute, Ottawa, Canada, has conducted studies on the solubilities of sludge metals in soils. Six acid soils with wide ranges of organic matter and clay content were used. Five anaerobic digested sewage sludges from various points in Ontario were incubated and mixed with the soil. The sludges used were iron chloride treated sludges from two different locations, alum treated sludge, untreated sludge, and a lime treated sludge, each from a different location. The extractable metals were measured either before and/or after incubation in 0.05M EDTA, 0.005 DTPA, and 0.01M CaCl2. Increased levels of extractable metals seemed related to the addition of sludge. A large increase in soil pH was caused by adding the lime treated sludge. Although soil texture affected the extractability of zinc it did not appear to do so with other metals.

*Sewage sludge, *Land, *Metals, Soil texture

Soil Research Institute, Ottawa, Canada

J118
REGULATORY ASPECTS OF SLUDGE UTILIZATION ON LAND,

Wood, G. M.

Ontario Ministry of the Environment, Toronto, Canada, Pollution Control Branch

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 110-119. 2 tab.

Regulation 824 of the Environmental Protection Act, in Canada, has been amended to designate and define organic waste processing and establish guidelines for construction and operation of organic waste sites. Haulers will now need a Certificate of Approval covering hauling and spreading equipment and for the number of sites needed for each individual sewage treatment plant. Guidelines have been set up for the sites covering location, land characteristics, management, and application rates of processed organic waste. The sites must be monitored for buildup of heavy metals and nutrients by the sampling of soils and crops. It is hoped that these guidelines with built-in safety factors will prevent permanent damage or degradation by the use of sludge on farmland. If damage does occur, due to hauler negligence or to plant errors in processing organic waste quality, the legal responsibility and compensation to the individual will need to be determined.

*Regulation, *Treatment facilities, Sites, Management, Organic wastes, Monitoring, Rates of application, Heavy metals, Nutrients, Damages, Compensation, Land, Soil analysis

Environmental Protection Act (Canada), Guidelines, Crop analysis, Spreading equipment, Haulers

J119
PROCEEDINGS, THIRD U.S.-JAPAN CONFERENCE ON SEWAGE TREATMENT TECHNOLOGY, FEBRUARY 12-16, 1974, TOKYO, JAPAN,

United States Environmental Protection Agency,
Cincinnati, Ohio

Publication No. EPA-670/9-75-005, May, 1975. 546 p.

Papers read at the third U.S./Japan conference on sewage treatment technology, held at Tokyo, Japan, in February, 1974 are presented. The Japanese government reviewed the Federal Water Pollution Control Act Amendments of 1972 and evaluated their contents as they apply to Japanese water policy. A summary of methods of heat treatment of sewage sludge in Japan, combined municipal/industrial treatment, and studies on advanced waste treatment in that country are presented. The papers from the United States discussed the Federal Water Act legislation from both federal and state viewpoints, and included a description of the Environmental Protection Agency's overall research program for waste water treatment. Other United States papers dealt with specific types of sewage and sludge treatment, such as: municipal waste water treatment and disposal facilities; sludge handling in Texas; physico-chemical nitrogen removal; sludges generated in phosphate removal; oxygen-activated sludge systems; aeration systems, suspended solids removal processes, and nitrification studies for Metro Chicago; and, an overview of U.S. storm and combined sewer abatement technology.

*Sewage treatment, *Conferences, *Waste water treatment, *Federal Water Pollution Control Act, Reviews, Legislation, Sludge treatment, Sewers, Heat treatment, Sludge disposal

*Japan, *Water policy, *U.S.-Japan Conference on Sewage Treatment Technology

J120
THE FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972. FEDERAL VIEWPOINTS,

Sutfin, C. H.

Office of Water Program Operations,
United States Environmental Protection Agency,
Washington, D. C.
Municipal Waste Water Systems Division

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 190-202.

The Federal Water Pollution Control Act Amendments of 1972 are discussed from the federal point of view. Efforts have been made between December 1972 and February 1974 towards implementing the Act. Three alternatives and criteria for the best practicable technology by 1974 are summarized. These involve treatment and discharge, land application, and reuse. Pre-treatment standards are defined by two major objectives which Congress has outlined. One objective is to prevent the introduction of pollutants which would pass through inadequately treated, and pre-treatment guidelines for incompatible pollutants are the same as for direct discharges. The other goal is the protection of the operation of publically owned treatment works. Planning of pollution abatement programs, infiltration/inflow regulation, and cost-effectiveness engineering are detailed. The financial needs of the program and the types of available federal financial assistance are reviewed.

*Federal Water Pollution Control Act, *Federal jurisdiction, Pre-treatment, Legislation, Reuse, Pollutant identification, Engineering, Costs

Land application

J121
THE FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972. STATE VIEWPOINT,

Whittington, D.

Texas Water Quality Board,
Austin, Texas

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 203-209.

The Federal Water Pollution Control Act Amendments of 1972 are discussed from the state viewpoint by a member of the Texas Water Quality Board. The Federal Water Act is highly structured so that all states may follow a uniform comprehensive program. For states that previously had no water pollution control programs this is advantageous. However, the state of Texas has required secondary treatment of sewage for 30 years, has had a permit program for municipal and industrial discharges since 1962, and has had a mandatory self-monitoring system since 1970. In order to incorporate these particular state programs into the federal pattern, all programs must be restructured. The Act, in its rigidity, fails to consider the regional differences between the states. However, it was concluded that the concepts of the Act--setting water quality standards, specifying minimum treatment levels, continuing a planning process, and monitoring pollutant discharges--are necessary and worthwhile.

*Federal Water Pollution Control Act, *Legislation, *State jurisdiction, Texas, Water pollution control, Water quality standards, Monitoring

J122
EPA OVERALL RESEARCH PROGRAM AND WASTEWATER TREATMENT RESEARCH,

Middleton, F. M.

National Environmental Research Center,
Environmental Protection Agency,
Cincinnati, Ohio

In: 3rd U.S.-Japan Conference on Sewage Treatment Technology, February 12-16, 1974, Tokyo, Japan, p 210-221. 8 tab.

The overall research program of the Environmental Protection Agency is described, with emphasis on its waste water treatment research. Four National Environmental Research Centers have been established at Cincinnati, Ohio; Corvallis, Oregon; Research Triangle Park, North Carolina; and Las Vegas, Nevada. Waste water treatment research is conducted by the Advanced Waste Treatment Research Laboratory in Cincinnati. Industrial waste treatment as well as the Storm and Combined Sewer Research Program are conducted at Edison, New Jersey. The budgets for municipal waste water research and industrial waste water research are about ten million dollars each. Several charts illustrate the administrative and organizational planning of the Office of Research and Development, of the EPA, and the NERC.

*Waste water treatment, *Research facilities, *Research and development, Administration, Planning, Municipal wastes, Industrial wastes, Waste treatment

*Environmental Protection Agency, *National Environmental Research Center

J123
DISINFECTION TO PROTECT RECREATIONAL AREAS AND POTABLE WATER SUPPLIES,

Kornder, L.

British Columbia Department of Health,
Vancouver, British Columbia, Canada,
Occupational Health Division

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, British Columbia, p 147-151.

The reasons for the necessity of disinfecting recreation and potable water supplies are outlined. The chief reason is the fact that enteric pathogenic bacteria are carried by water and will contaminate the aquatic environment. Some of the currently held standards for recreational water quality are based on the fecal coliform count since this nonpathogenic bacteria is associated with the more difficult to isolate Salmonella. However, the recent information concerning the carrying of resistance factors (R factors) by coliforms may result in a change in the current water standards. Disinfection of waste water may be accomplished by using chlorine, bromine, iodine, ozone or ultraviolet light. Chlorine disinfection is the most widely used method. The medical consensus in Canada is that chlorination of waste water discharged to recreational water is essential. Chlorination is also the current most feasible method of disinfecting potable water. A few of the factors which influence the efficacy of chlorine disinfection include: the level of SS; ammonium content; pH; nitrites; iron; and, reaction time.

*Public health, *Waste water treatment, *Chlorination, *Disinfection, *Potable water, Ozone, Coliforms, Enteric bacteria, Pathogenic bacteria, Water treatment

*Recreational waters

J124
MUNICIPAL SEWAGE TREATMENT TO PROTECT SHELLFISH GROWING WATERS,

Tevendale, T. J.

Environmental Protection Service, Pacific Region,
Vancouver, British Columbia, Canada,
Water Quality Program

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, British Columbia, p 153-170. 3 tab, 8 ref, 2 append.

Environment Canada is responsible for the sanitary control of the Shellfish Fisheries in British Columbia. Their duties include assessing and classifying the growing water quality of shellfish waters. The bacteriological criteria for an approved shellfish growing water is that the coliform median MPN does not exceed 70/100 ml and not more than 10% of the samples ordinarily exceed a MPN of 230/100 ml for a 5 tube, 3 decimal dilution test in those portions of the area most probably exposed to fecal contamination during the most unfavorable hydrographic and pollution conditions. The percent reduction of coliform bacteria expected from various types of treatment processes is discussed. The highest reduction is expected from stabilization ponds. The operational reliability of treatment plants and sewage collection systems is the most important factor in the protection of shellfish growing waters. Suggested methods for the protection of growing waters include: more effective methods of disinfection; zero discharge to shellfish waters of domestic wastes; utilization of seasonal holding lagoon systems during the harvesting season; and, institution of the concept of positioning sewage treatment plants and outfalls in accordance with plans developed by agencies responsible for administration of public health, installation of treatment systems, land use, and protection of renewable resources.

*Public Health, *Waste water treatment, *Commercial shellfish, Sewage treatment, Mollusks, Lagoons, Coliforms, Water quality control, Water pollution control

J125
TOXICITY TO AQUATIC ORGANISMS CAUSED BY CHLORINATION,

Servizi, J. A.

International Pacific Salmon Fisheries Commission,
New Westminster, British Columbia, Canada,
Environmental Conservation Division

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, British Columbia, p 171-182. 1 tab, 24 ref.

Field and laboratory studies have been performed which have demonstrated the toxicity of chlorinated municipal sewage to fish and other aquatic organisms. It has been proposed that the total residual chlorine should not exceed 0.002 mg/liter in areas receiving chlorinated wastes continuously. In areas where disinfection is required to protect public health, alternative methods of disinfection should be used, such as chlorination-dechlorination and ozonation. Chlorination-dechlorination has been shown to be beneficial in protecting both public health and aquatic life. Dechlorination can be effected by impounding freshly chlorinated sewage in lagoons. Although lagooning results in secondary regrowth of coliforms, it is hygienically acceptable since there is presumably no regrowth of pathogenic bacteria. In the absence of chlorination, primary sewage effluents were found to be toxic to fish, while effluents from secondary treatment were essentially nontoxic. Acute toxicity or sublethal toxic conditions for fish are present when chlorine residuals exceed 0.02 mg/liter. Chlorinated municipal sewage may have a combined available chlorine residual from 0.1 mg/liter to 3-4 mg/liter. Therefore, the major step in obtaining a nonlethal treated municipal sewage is limitation of chlorine residual to less than 0.02 mg/liter. Current technology and principles make it possible to discharge a suitable treated waste water which is nontoxic to aquatic organisms and which will not cause public health problems.

*Public health, *Waste water treatment, *Chlorination, *Fish, *Toxicity, *Aquatic organisms, Sewage treatment, Pathogenic bacteria

J126
THE EFFECTS OF AEROBIC AND ANAEROBIC INCUBATION ON THE EXTRACTABILITIES OF HEAVY METALS IN DIGESTED SEWAGE SLUDGE,

Bloomfield, C., and Pruden, G.

Rothamsted Experimental Station,
Harpenden, Herts, Great Britain

Environmental Pollution, No. 8, p 217-232, 1975. 10 fig, 1 tab, 16 ref.

The solubilities of Zn, Ni, Cu, Pb, Cd, and Cr in sludge were investigated as affected by aerobic and anaerobic incubation. Digested sludge from the Upper Tame Drainage Authority, Great Britain was used as taken from the drying bed. Variation in pH of the digested sludge during various treatments was shown graphically. Wide variation in the extractability of the metals as well as in the reagents commonly used to assess availabilities of trace metals to plants, such as acetic acid and EDTA, were found. This extractability may increase or decrease, depending both on whether the conditions are anaerobic or aerobic and upon the element and the extractant. No consistent trends were found in the addition of soil and/or lime to the sludge as it related to solubilities of these metals during aerobic incubation.

*Heavy metals, *Extraction, Aerobic treatment, Anaerobic treatment, Zinc, Nickel, Copper, Lead, Cadmium, Chromium, Sludge, Solubility, Sewage, Hydrogen ion concentration, Lime

J127
EFFECT OF NUTRIENT INPUT REDUCTION ON THE EUTROPHICATION OF THE MADISON LAKES,

Sonzogni, W. C.

Wisconsin University,
Madison, Wisconsin

Dissertation Abstracts International B., Vol. 35, No. 11, p 5713-5714, 1975.

Nutrient loadings have been estimated for each of the Madison (Wisconsin) lakes. It has been seen from current and historical data that phosphorus concentrations are reduced when sewage effluent is diverted from entering the lakes. This indicates that external inputs, rather than lake sediments, are the controlling factors in phosphate concentration. Sewage diversion around Lake Mendota in 1971 reduced the average annual phosphorus loading by about 20 percent. However, observation over a three year period showed that the effect of this diversion was obscured by yearly variations in loadings from other sources, such as runoff. Phosphorus accumulation rates per unit area of anoxic sediment in Lake Mendota were shown to be similar to rates for other eutrophic lakes. Linear models to predict the rate and extent of recovery of a lake following phosphorus input reduction were evaluated. A phosphorus residence time model may be used to predict the steady-state mean phosphorus content of the lake which will be reduced in direct proportion to the change in input. It was concluded that only ambiguous evidence exists for the increases in phosphorus levels in Lake Mendota.

*Nutrients, *Lakes, *Phosphorus, Sewage disposal, Model studies, Effluents, Runoff

J128
OPTIMAL REGIONALIZATION OF WASTEWATER TREATMENT FACILITIES FOR WATER QUALITY MANAGEMENT,

Rossman, L. A.

Illinois University,
Urbana, Illinois

Dissertation Abstracts International B., Vol. 35, No. 11, p 5462, 1975.

In this dissertation, a mathematical decision model was developed for determination of how several waste dischargers might regionalize their treatment facilities in order to achieve a water quality goal at minimal cost. A dual approach to nonlinear planning is used with a branch and bound procedure to resolve any duality gaps which may occur due to the nonconvex nature of the problem. Treatment plant and piping costs for waste dischargers assumed to lie in a linear configuration along a river were used as functions of waste flow. The model was applied to data for the Delaware Estuary and favorable results were indicated. The model has also been extended to consider branched systems and the use of bypass piping. Additional minimum cost, regional waste water treatment models were developed. One finds the regional treatment facility pattern with a fixed degree of treatment; the other finds the regional facility pattern and uniform level of treatment for all facilities which meet a specified water quality goal.

*Regional development, *Decision making, *Mathematical models, *Waste water treatment, Costs, Facilities, Water quality control, Planning

Waste discharge

J129
WATER QUALITY MANAGEMENT IN A METROPOLITAN AREA,

Dorcey, A. H. J., and Hall, K. J.

British Columbia University,
Vancouver, British Columbia, Canada,
Westwater Research Centre

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, British Columbia, p 195-217. 4 fig, 11 tab, 8 ref.

The information required for water quality management in a metropolitan area, specifically the Lower Fraser Estuary of metropolitan Vancouver, British Columbia, Canada, is discussed.. The parameters to be considered in water quality management include dissolved oxygen, BOD, pollution indicator microorganisms (total coliforms, fecal coliforms, and fecal streptococci), nutrients (mainly nitrogen and phosphorus), trace metals, pesticides, and other toxic substances, such as hydrocarbons, phenols, and other organic compounds. The data collected show that pathogenic microorganisms, trace metals, and pesticides resulting from the metropolitan Vancouver area all present potential pollution problems. Information must be generated to determine the sources of these pollutants if the quality of the water environment in the Lower Fraser is to be managed. The information presently available is inadequate for determining the sources and for developing management plans. Data from the California Bight and New York City are illustrated to show the importance of pollution source information in determining whether the implementation of a particular management plan will be effective in producing the desired improvement in water quality. Current studies are being performed to provide a better understanding of the significant sources of these pollutants and the opportunities for their most cost-effective control.

*Municipal wastes, *Water pollution sources, *Water pollution control, *Water quality control, Biochemical oxygen demand, Indicator organisms, Coliforms, Pesticides, Chlorinated hydrocarbons, Heavy metals, Rivers, Nutrients, Nitrogen, Phosphorus, Phenols, Organic pollutants, Canada, Foreign research

Lower Fraser River, Vancouver, B.C., Canada

J130
CANADIAN DRINKING WATER SURVEILLANCE PROGRAMS, PANEL DISCUSSION,

Tupper, C. E.

Department of Public Health,
Halifax, Nova Scotia, Canada,
Division of Public Health Engineering

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, British Columbia, p 243-245.

The Canadian Water Standards and Objectives are currently used by each of the Atlantic provinces of Canada as either a legal requirement or as a reference guideline for evaluating and assessing municipal water supplies. All of the public systems in Prince Edward Island meet the Standards mainly because the public supplies there are all groundwater. In Nova Scotia, New Brunswick, and Newfoundland, the majority of public water supplies are surface water sources; many of these public systems cannot meet the requirements of the Standards during the winter. Upgrading of the public systems has included the installation of pH adjustment, filtration plants, and appropriate chemical feed systems for chlorination. Although there is a general soft water corrosiveness of the water, chemical quality is not a major problem in the Atlantic Provinces. The Canadian Standards can be achieved in the long run in these provinces without any difficulty. However, a period of several years will be needed to bring all systems to the desired quality level. The Canadian Drinking Water Standards and Objectives have been an important aid in establishing better drinking water surveillance programs in the Atlantic Provinces, and in encouraging an improvement in overall quality of the public water supplies.

*Potable water, *Water supply, Water quality, Canada, Standards, Water treatment, Chlorination, Filtration, Corrosion control

J131
CANADIAN DRINKING WATER STANDARDS REVIEW, ONTARIO'S PROGRAMS, PANEL DISCUSSION,

Kay, G. H.

Ontario Ministry of the Environment,
Toronto, Ontario, Canada,
Contingency Planning Section

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, British Columbia, p 247-252.

A review is presented of the Canadian Water Standards with respect to the actions necessary to achieve these goals. The implementation of drinking water standards or objectives is highly desirable and permits a technical assessment to be made of the product being provided. The Ontario Ministry of the Environment is starting the E.D.P. storage and retrieval of water analysis results to accelerate the assessment of water quality. The Province of Ontario is initiating a program of training, leading to the mandatory certification of water treatment plant operators. Miniaturization of the sampling units would aid in organic chemical determinations. The Ministry is trying to protect the natural waters since the quality of the water source affects the quality of the drinking water. Legislation since 1957 has encouraged advanced treatment of waste flows and drinking waters. The presence-absence test, a simple modification of the most probable number method, is used in addition to the multi-filter technique to provide a sensitive test of the presence of pathogenic micro-organisms. Other steps taken to ensure the best possible drinking water include: detection of asbestos fibers in drinking water by electron microscopy; monitoring organic chemicals; filtration as well as disinfection treatment is required of all surface water supplies; water reservoirs must be covered; automatic continuous recording analyzers for turbidity and chlorine residuals are required at filtration plants; and, regionalization is encouraged to discourage the growth of small plants.

*Water treatment, *Potable water, *Standards, Canada, Treatment facilites, Filtration, Disinfection, Pathogenic bacteria, Groundwater, Surface waters

*Canadian Drinking Water Standards and Objectives

J132
CANADIAN DRINKING WATER STANDARDS REVIEW, ALBERTA, SASKATCHEWAN AND MANITOBA, PANEL DISCUSSION,

Briggs, R. N.

Department of Environment,
Edmonton, Alberta, Canada,
Division of Pollution Control

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, British Columbia, p 253-256.

The Prairie Provinces of Canada, Alberta, Saskatchewan, and Manitoba, have accepted the Canadian Drinking Water Standards but due to physical limitations the Standards are used more like guidelines. The surface water and groundwater quality decreases from Alberta through Saskatchewan to Manitoba. The Province of Manitoba has adopted the Canadian Drinking Water Standard with the modification that their optimum fluoride level is 1.0 mg/liter, with an operating range from 0.8 to 1.2 mg/liter. Of the 199 water works systems in Manitoba, only 4 use water that meets the Water Quality Objectives, 24 use acceptable water, and the remaining 72% use water outside of the Standards. The Province of Saskatchewan uses the values corresponding to the Maximum permissible limit in the Drinking Water Objectives. The Objective Values have been modified: sodium limit = 300 mg/liter; sulfate limit = 500 mg/liter; T.D.S. = 1500 mg/liter; hardness = 800 mg/liter; alkalinity = 500 mg/liter; and, phenolics = 0.001 mg/liter. The Province of Alberta has adopted the Canadian Drinking Water Standards, with the exceptions as determined by the Director of Standards and Approvals.

*Potable water, *Water supply, *Standards, Water quality, Canada, Groundwater, Surface waters

*Canadian Drinking Water Standards and Objectives

J133
CANADIAN DRINKING WATER STANDARDS REVIEW, BRITISH COLUMBIA, PANEL DISCUSSION,

Bailey, W.

Department of Health,
Victoria, British Columbia, Canada,
Environmental Engineering Division

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, British Columbia, p 257-261.

The quality of the potable water supplies in British Columbia, Canada, and measures taken to protect the drinking water are discussed. The B.C. Health Branch has published "Recommended Water Quality Standards", however, this document has no legal standing. The part of the standards dealing with potable water supplies is similar to the Canadian Drinking Water Standards. Very few of the water works systems in B.C. have full water treatment. Data processing storage and retrieval of water-works information is just beginning to be implemented. An annual Water and Waste School is held at the University of British Columbia to produce well trained, competent operators for the waterworks systems. Open reservoirs on waterworks distribution systems must be covered or abandoned. The following programs must be initiated with supporting legislation and staff: controlled multiple use of watersheds to protect raw water quality; establishment of minimum drinking water quality standards for bacteriological, chemical and physical characteristics; prevention of contamination of water in the distribution system by cross-connection control programs, increasing water pressure, prohibiting open reservoirs, and promoting proper maintenance programs; consolidation of small water systems into larger, better managed systems; and promotion of waterworks operator training and certification.

*Potable water, *Water supply, *Water quality, *Standards, Canada

*Canadian Drinking Water Standards and Objectives

J134
CANADIAN DRINKING WATER STANDARDS REVIEW, NORTHWEST TERRITORIES AND YUKON TERRITORY, PANEL DISCUSSION,

Grainge, J. W.

Environmental Protection Service,
Edmonton, Alberta, Canada

In: Proceedings of the Annual Conference of the British Columbia Water and Waste Association, April 9-11, 1974, British Columbia, p 261-263.

The control of the water supplies in the two northern territories of Canada is discussed. The Canadian Drinking Water Standards are used as a guide for water quality. Half of the people in the two territories use water which meets, or nearly meets, the Standards. Most of the rest of the people have access to good quality water although the water is subject to contamination during haulage and storage. Bacterial contamination, color, and turbidity are the parameters which are not met in the substandard water. Water wells are fairly productive in the Yukon Territory but are not used in the Northwest Territores because of the high mineralization of the water. Administrative control of water quality in most communities is performed by self-governing councils which accept advice from the local offices of the Department of National Health and Welfare and the area MHO's and EHO's. The local health officer should supervise the water sampling for bacteriological control and the testing for chlorine. The greatest need in the northern Canadian territories is for community planning so that water mains and sewers can be constructed.

*Water supply, *Potable water, Water quality, Standards, Canada, Sewers

*Canadian Drinking Water Standards and Objectives

J135
ENVIRONMENTAL WATER QUALITY PROGRAM,

Obrecht, M. F., Downes, W. E., Jr., and Valiquet, R. W.

Department of Aviation,
Chicago, Illinois,
Environmental and Chemical Engineering Consultant

Heating, Piping, Air Conditioning, Vol. 47, No. 6, p 47-53, June, 1975. 10 ref.

The history of the O'Hare Water Quality Section of the Department of Aviation, City of Chicago, Illinois, is discussed from its beginning in October 1971 to the present. The ultimate objective of the program is to allow the airport to maintain strict compliance with existing and future regulations through continuous monitoring and testing. The O'Hare International Airport has the typical operations of most major airports including: aircraft fueling and maintenance; vehicle servicing; aircraft lavatory servicing; continuous construction and remodeling; land fill; and, grading. A Master Water Quality Control Program has been developed. An emergency oil spill plan is part of this master program. Communication equipment, portable booms, sorbent material, pump-out and skimming equipment, shovels, sledgehammers, stakes, lines, boots, lifejackets, available holding tanks, and earth moving equipment are some of the equipment necessary for an efficient oil containment and removal program. The Technical Committee for Present and Future Water Control Projects was formed to be representative of all the tenants of the airport. The committee will discuss violations and common problems, pass resolutions, and field test proposed solutions. The establishment of a Master Water Quality Control Program is believed to be necessary for the compliance with present and future water quality standards at any airport. The programs instituted at O'Hare may also be applied to tank farms, railroad terminals, and industrial complexes.

*Airports, *Water pollution control, *Water quality, Administration, Oil spills, Industrial wastes, Sewage, Fuels

Master Water Quality Control Program

J136
DIGESTER GAS: VALUABLE PLANT FUEL,

Everett, A. D.

South Burlington Waste Treatment Plant,
Burlington, North Carolina

Water and Sewage Works, Vol. 122, No. 5, p 60-61, May, 1975. 4 fig.

The South Burlington waste treatment plant, Burlington, North Carolina, uses digester gas (essentially methane) to power three 150-hp engines at a rate of 1200 scfh to drive the centrifugal blowers for the aeration tanks. Approximately $4,000 per year in fuel costs are saved by using digester gas instead of natural gas. American Meter rotating-vane type positive displacement meters have been installed in place of the conventional diaphragm meters commonly used for a check on digester gas consumption. Two meters are used in the system, one measures digester gas to the three air blower engines and the other measures excess digester gas that must be consumed in a waste burner. Greater than 95% of the digester gas produced is normally used. Periodic readings of the two meter totalizers show the total gas usage. An interchangeable measuring cartridge contained on the CVMP-S meter simplifies maintenance and maintains the meter's accuracy. Dirt, pipe scale, and corrosive vapors are prevented from reaching the gears by a magnetic drive on the meter which enables the gear box to be isolated from the flowing digester gas. Pre-lubricated bearings are sealed so that they are not exposed to the degreasing effect of digester gas condensates. The meters may be installed horizontally in three-inch pipe loops or mounted in vertical lines.

*Methane, *Instrumentation, Natural gas, Fuels, Equipment

*Digester gas

J137
BIOLOGICALLY MEDIATED INCONSISTENCIES IN AERATION EQUIPMENT PERFORMANCE,

Albertson, O. E., and DiGregorio, D.

Eimco BSP,
Salt Lake City, Utah
Division of Envirotech Corporation

Journal of the Water Pollution Control Federation, Vol. 47, No. 5, p 977-988, May, 1975. 9 fig, 5 tab, 4 ref.

The basic methods used to evaluate the performance of aeration equipment are based on classical aeration theory which states that oxygen transfer is a function of dissolved oxygen (DO) driving forces and the overall transfer coefficient of the physical-liquid system only. However, performance data suggests that this basis is incorrect. Aerator efficiency, corrected to standard conditions, has been shown to be directly related to activated sludge respiration rate. Steady-state oxygen transfer evaluations were performed at several full-scale activated sludge plants. These demonstrated a relationship between mixed liquor uptake rate and the measured standard oxygen transfer capacity. The direct transfer of oxygen from gas bubbles present within the mixed liquor to the microorganisms is concluded to be responsible for this phenomenon. The evidence shows that oxygen is available not only through the two-film oxygen diffusion pathway of classical theory, but also by direct transfer of oxygen from air bubbles to the active mass. Activated sludge system design should be modified to take advantage of direct bubble contact. This would achieve savings in capital and operating costs.

*Waste water treatment, *Aeration, *Activated sludge, Dissolved oxygen, Bubbles, Costs

*Oxygen transfer

J138
PROCEEDINGS OF THE ANNUAL CONFERENCE OF THE BRITISH COLUMBIA WATER AND WASTE ASSOCIATION,

April 9-11, 1974. 272 p.

The 1974 annual conference of the British Columbia Water and Waste Association was held in Vancouver, British Columbia, during April 1974. Papers were delivered on the topics of: water resources; water rates; pump selection; water supply; role and responsibilities of the Environmental Protection Service (Canada); horizontal groundwater collectors; and, oil spill technology. Actual treatment methods discussed included disinfection, alternatives to disinfection, package treatment plants, and spray irrigation of sewage. A panel discussion was held on the Canadian Drinking Water Standards and Objectives with respect to the programs carried out by the provinces to insure that they are providing suitable drinking water to their residents.

*Waste water treatment, *Potable water, *Water supply, Water resources, Groundwater, Sewage, Irrigation, Disinfection, Pumps, Chlorination, Standards, Water quality, Canada, Oil spills

Horizontal groundwater collectors, Environmental Protection Service (Canada)

J139
ENERGY CONSERVATION: AN ESSENTIAL AND URGENT PROBLEM FOR THE WATER INDUSTRY,

Young, J. A.

Water, No. 3, p 12-14, April, 1975. 3 fig, 5 ref.

Water authorities as well as other industries are now confronted with the urgent and essential need to conserve energy. The water industry has its peak electricity demand during the summer as opposed to the general peak demand during the winter months. The advanced technology in treatment of water and sewerage has proven to be more energy consuming than older methods. The slow sand filter method of water treatment which from a bacteriological viewpoint produces a better filtrate than the newer more energy consuming rapid gravity filter is regaining favor. The traditional rotary biological filters used in sewage disposal operated on gravity but have been replaced by oxygenation ditches, and activated sludge which require energy. Sewage disposal at sea could provide an energy conserving, efficient method of disposal in coastal areas. At the Essex Water Authority's Avonmouth Recovery Works the methane gas produced by sludge digestion is producing 55% of the electricity used to power the works.

*Water treatment, *Sewage treatment, Filters, Oxygenation, Activated sludge, Sewage disposal, Methane, Sludge digestion

Energy conservation, Water industry

J140
LIAISON WITH PLANNING AUTHORITIES - A VITAL LINK,

Satchell, R.

Water, No. 3, p 9-11, April, 1975. 1 fig.

The need for cooperation between water authorities and local planning agencies is essential to providing proper water services. This need was recognized by Section 24(8) of the Water Act 1973 making it necessary for water authorities to take development plans, local plans, and structure plans into account and consult with local authorities. The Severn Trent Water Authority arranges a meeting about once a year with the county officials, regional economic planning councils, managers of new towns, and the central and regional Department of Environment. Planning applications are part of the on-going responsibilities of the water authority which are passed on to the proper division to get their opinions on the appropriate water reclamation and supply. The water authority must keep the counties and districts informed of the intent and content of their short and medium term programs. Although the water authority should contribute to the planning process it is not their purpose to usurp the function of local planners.

*Water policy, *Water supply, *Legislation, *Administration, Comprehensive planning, Decision making

Water authorities, Great Britain

J141
NORTH WEST: A DIRTY INHERITANCE,

Water, No. 3, p 19-22, April, 1975. 3 fig.

The North West Water Authority covers the area of northwest England including Liverpool, Manchester, and the Lake District with a population of approximately seven million. For many years the water supply for both Manchester and Liverpool has come from the Lake District and north Wales. As a result little concern was shown about the discharge of effluents into the rivers causing pollution. Some of the tasks facing the North West Water Authority are improving water distribution in rural areas, sewerage in the rural areas, and the pollution in the Mersey Belt and other parts of the region. Future industrial and residential development of the area is an important factor in the North West Water Authority's capital planning along with cooperation with the local authorities. The future organization of the Authority will include seven divisions, five of which will be in the heavily populated southern half of the area. There will be a single division for river management. Water recreation needs are another of the Authority's concerns. The Lake District is a well known recreational area as well as the coastal resorts. Some of the coastal waters are not suitable for boating or other water sports. The authority hopes to expand recreation on the waters under its jurisdiction nearer population centers. The development of fisheries and recreational facilities as well as the clean up of coastal waters, rivers and estuaries will require major investments.

*Water sources, *Water pollution, Water supply, Administration, Planning, Recreation facilities, Investment, Rivers, Estuaries, Fisheries

England, North West Water Authority, River management, Coastal waters

J142
WATER CONSERVATION IN SWEDEN: II. POLLUTION CONTROL,

Liedberg, A., and Olsson, I.

Journal Water Pollution Control Federation, Vol. 47, No. 4, p 669-672, April, 1975.

During the last century there has been a definite redistribution of population in Sweden from almost 90% rural to over 80% urban. At the same time the population has doubled. Heavy pollution in lakes, rivers, and coastal waters occurred as a result of the urbanization, population growth, and municipal waste regulations. Eutrophication was increased by the use of synthetic detergents. In the 1960's the Swedish government instituted action programs and policy goals to prevent further deterioration of the environment. The Environmental Protection Act became effective in 1969 to regulate the use of land and supervision of activities hazardous to the environment. Prior to the enactment of the Environmental Protection Act only 50% of the urban households were connected to biological treatment plants, 25% to primary treatment plants, and 25% no treatment plants. Presently 50.6% are connected to chemical and biological/chemical treatment, 40.6% biological treatment, 7.8% sedimentation and 1% no treatment. Technological progress and government grants as well as legislation and political goals resulted in this rapid progress. Guidelines for the treatment and disposal of sludge are in preparation. Positive effects of these programs have been the restoration of heavily polluted areas, a decrease in algal growth, and a recolonization by fish.

*Legislation, *Waste water treatment, *Pollution abatement, Urbanization, Population, Detergents, Eutrophication, Bodies of water, Environmental effects, Treatment facilities, Municipal wastes, Sludge treatment, Sludge disposal

Sweden, Environmental Protection Act

J143
HISTORICAL AND LEGAL ASPECTS OF NEPA,

Noble, C.

Water and Sewage Works, Vol. 122, No. 5, p 86-88, May, 1975. 8 ref.

The National Environmental Policy Act (NEPA) was signed into law on January 1, 1970. The historical and legal aspects of NEPA are discussed. Although the original act was really only a statement of good intention, its action forcing provisions stated that: a systematic interdisciplinary approach will be used by the agencies to insure integrated use of the natural and social sciences and the environmental design arts; and, methods will be developed to give appropriate consideration in decision making to presently unquantified environmental amentities. The main feature of the Act is the provision that requires each Federal agency to submit a statement of environmental impact in advance of each major action, recommendation or report on legislation that may significantly affect the quality of the human environment. Areas of uncertainty, such as what projects are "significant" enough to require an impact statement and what degree of latitude should exist between agency interpretations, exist under NEPA. The results of several court cases which have helped to clarify the interpretation of NEPA are presented.

*Legislation, *Water pollution control, Legal aspects, Environmental effects

*National Environmental Policy Act (NEPA), Environmental impact statements

J144
RESORT COMMUNITY PUTS ALL UTILITIES UNDERGROUND,

Water and Sewage Works, Vol. 122, No. 5, p 94-95, May, 1975.

Kingsmill on the James is a 2900 acre resort and residential development in Virginia. Construction was begun in 1972 and is expected to continue 15 years. One of the earliest construction phases was the placing of electricity, water, sewer and telephone lines underground. Armco Truss Pipe is being installed for the sanitary sewers. The pipe is made by extruding ABS (acrylonitrile-butadiene-styrene) resin into a truss shape to form an inner and outer wall supported by webs. The voids between the webs are filled with lightweight concrete. The pipe is about three times longer than vitrified clay pipe which allows for fewer joints and faster installation. The joints are solvent welded to reduce infiltration/exfiltration. Separate contracts were signed on four different residential sites in Kingsmill on the James. In each case, the successful contractor bid the Armco pipe substantially lower than the VCP.

*Pipes, *Sewerage, Plastic pipes, Construction materials, Clay pipes, Joints (connection), Infiltration, Costs

Armco Truss Pipe, Acrylonitrile-butadiene-styrene

J145
ARE CHEMICALS USED IN ALGAE CONTROL BIODEGRADABLE?,

Fitzgerald, G. P.

Water and Sewage Works, Vol. 122, No. 5, p 82-85, May, 1975. 5 tab, 7 ref.

Concern about the use of toxic chemicals to control the growth of nuisance algae has led to a study on the biodegradability of these substances. The simple procedure used for testing various commercial algicides was to apply the initial dosage required to stop the growth of the algae present, reinnoculate with algae, and then observe whether additional algicide was needed to stop the growth of reintroduced algae. If no additional dose was required, this was taken as an indication that the chemical was not biodegraded by the algae. If additional chemical was needed, it was assumed that the initial dose had been biodegraded. Of the products containing copper, silver, mercuric chloride, phenyl mercuric acetate, and quaternary ammonium compounds tested over the last 11 years, all were found to be biodegraded by the treated algae. However, methyl mercuric chloride is not detoxified by the action of treated algae and its use as an algicide would be a threat to the aquatic environment. It is recommended that because methyl mercuric chloride has been determined to be non-biodegradable, all chemicals to be added to aquatic environments should be evaluated.

*Algicides, *Toxicity, *Biodegradation, Chemicals, Copper, Silver, Analytical techniques, Environmental effects, Aquatic organisms

Methyl mercuric chloride

J146
LAND DISPOSAL OF SEWAGE SLUDGE,

Bates, T. E., Beauchamp, E. G., Ketcheson, J. W.,
Protz, R., Moyer, J. R.

Guelph University, Guelph, Ontario, Canada, Department of Land Resource Science

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 143-149.

An outline is presented of the research being performed at the University of Guelph, Guelph, Ontario, on the land disposal of sewage sludge. The major objective of the research is to determine maximum rates of sewage sludge application which can be used on agricultural soils without contaminating subsurface water with nitrate nitrogen and surface water with pathogenic organisms, and without lowering the quality of the crops grown. Specific research is being performed to determine rates of sewage sludge which may be safely applied to certain slopes at specified times of the year and to examine the movement of nutrients and other components of sludge on field plots. Field rate and source studies should provide conditions for nutrient, metals, bacteriological and soil characterization studies. Nutrient and heavy metals research is being done to determine the application rates of chemically treated sludges which may be used on typical Ontario soils without being detrimental to crop and soil nutrient and heavy metals content. Studies on nitrogen have two objectives: to determine the availability to plants of nitrogen in chemically treated sludges, and to estimate the losses of nitrogen to groundwater. In addition to the above studies, research is being conducted to establish a simple chemical test for plant available metals in soils by selecting suitable extractants with particular emphasis on copper and cadmium, to determine the numbers of total coliforms, fecal coliforms and fecal streptococci in the sludges, and to characterize the soils in terms of soil structure and movement of Ca, Fe, and Al used in sludge treatment.

*Sludge disposal, *Fertilization, *Soil science, *Sewage sludge, *Heavy metals

J147
NITROGEN TRANSFORMATION AND UPTAKE,

Beauchamp, E. G., and Moyer, J.

Guelph University, Guelph, Ontario, Canada, Department of Land Resource Science

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 159-173. 9 fig, 10 ref.

Some of the more important transformations of sludge nitrogen and their importance to crops and the environment are discussed. Nitrogen is one of the limiting factors in the disposal of sewage sludges on agricultural land. The total organic N content of anaerobically digested sludges may vary between 0.1 and 0.3 on a fluid basis. The ammonium nitrogen (NH4-N) content may be between 2 and 50% of the total N. Transformations discussed include: mineralization of organic N; conversion of NH4 to NO3 via nitrification; volatilization of NH3; immobilization of organic N, NH4, and NO3 by soil microorganisms; NH4 fixation in clays; and, denitrification of NO3. The nitrification process involving the conversion of NH4 to NO3 is the most important from the point of view of crop uptake and ground or surface drainage water pollution. Results of the experiments performed are given. The main conclusion is that sludge should not be applied in quantities which supply more available N (NH4) than the crop requires. This will prevent the NO3 pollution of ground and drainage waters as well as preventing an excessive uptake of NO3-N by plants which could be harmful to ruminants.

*Sludge disposal, *Fertilization, *Nitrogen cycle, *Crop response, Nitrification, Denitrification, Nitrogen fixation, Leaching, Groundwater, Surface waters

Land application

J148
SOME MICROBIOLOGICAL ASPECTS OF THE LAND DISPOSAL OF SLUDGE,

Johnston, R. A.

Guelph University,
Guelph, Ontario, Canada,
Department of Microbiology.

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 185-191. 1 fig, 2 tab.

Research being conducted at the University of Guelph, Ontario, on the land disposal of sewage sludge includes studies to establish the numbers of some groups of indicator bacteria in run-off waters and sludges, and to determine the presence or absence of pathogens such as Salmonella and Shigella in sludges, run-off waters and on plants harvested from areas receiving sludge. Examination was made of sludge applied, runoff from control and treated plots, and plots growing corn and grass. Preliminary observations include: the examination of sludge and run-off water for the estimation of commonly employed indicator organisms has little value in assessing the influence of sludge on run-off water; the number of Salmonella and Shigella bacteria found in sludge and run-off water appears to be quite low; and, some Salmonella and Shigella forms seem to be capable of surviving for a short time in sludge and sludge-soil mixtures.

*Sludge disposal, *Fertilization, *Bioindicators, *Pathogenic bacteria, Runoff, Salmonella, Shigella, Public health

J149
CATION DISTRIBUTION IN SOILS AS RELATED TO SEWAGE SLUDGE DISPOSAL ON LAND,

Protz, R.

Guelph University, Guelph, Ontario, Canada, Department of Land Resource Science

In: Sludge Handling and Disposal Seminar, September 18-19, 1974, Toronto, Ontario, Canada, Ontario Ministry of the Environment, Pollution Control Branch, 125 St. Clair Avenue West, Toronto, Ontario M4V 1P5, p 192-206. 15 fig, 3 tab, 10 ref.

Research being conducted at the University of Guelph, Ontario on the land disposal of sewage sludge includes a study to demonstrate variation of soils at the macro (field plot) and micro (cation) scales. This type of data will have to be included in the development of final guidelines for soil sampling and analyses. Clay content influences the pH and variability of CaCO3 by influencing the amount of water passing through the soil. Soils with greater clay contents have less variation than coarse textured soils. The potential maximum variability of cations with depth in a soil is demonstrated with two profiles 12 inches apart in coarse textured soils. This variability is caused by the inherent fluvial parent material and the influence of trees on soil formation. Distribution of cations within the soil profile is under the ultimate control of their solubility products, porosity of the soil, and the micro variations in the soil moisture regime. The "final" distributions of cations within the soil on the microscopic scale are illustrated by micrographs of the different pedological precipitates and concretions found in soils. In order to dispose of waste on agricultural land for food production under environmentally safe conditions, it is necessary to understand the variability of cations in soils to accurately monitor the system.

*Sludge disposal, *Fertilization, *Soil science, *Cations, *Soil profiles, Soil horizons, Soil moisture, Soil physical properties, Soil structure

J150
COMPOSTING AND USE OF COMPOST IN SWEDEN.

Hovsenius, G.

National Environmental Protection Board, Solna, Sweden.

Journal Water Pollution Control Federation, Vol. 47, No. 4, p 741-747, April, 1975. 3 tab.

A number of municipal waste water treatment plants for biological oxygen demand (BOD) and phosphorus removal have been constructed over the past ten years as a result of a strong environmental policy in Sweden. This in turn has resulted in a rapid increase in the quantity of waste water sludge. The presence of more than 1,000 treatment plants makes sophisticated sludge handling techniques economically prohibitive. More than 60% of the sludge is disposed of in landfills. Composting would be an alternative to incineration to solve the sludge and garbage problems in small communities. Since composting is relatively untested in northern Europe, a test plant was built at Laxa, Sweden to be operated over a three year period by the National Environmental Protection Board. The plant will perform physical, chemical, and bacteriological analyses of nondigested wastes, digested materials, and cured compost for organics, mercury and other heavy metals, pesticides, coli, salmonella, virus, and parasites. Health hazards for plant personnel will be surveyed. Composting processes and technology in relation to different sludges will be evaluated. A cost analysis of the operation will also be done. Groundwater contamination from compost will be investigated. Both greenhouse and outdoor experiments will be conducted to determine the enrichment of heavy metals in soil and plants.

*Sewage sludge, *Sludge treatment, *Sludge disposal, Treatment facilities, Waste water treatment, Testing, Chemical analysis, Cost analysis, Wastes, Groundwater, Water pollution, Heavy metals, Soils, Public health

J151
DETERGENTS,

Banerji, S. K.

MCA Engineering Corporation,
Baltimore, Maryland.

Journal of the Water Pollution Control Federation, Vol. 47, No. 6, p 1273-1278, June, 1975. 25 ref.

The literature on the treatment of detergent containing waste water was reviewed. A phosphorus detergent ban in New York state reduced the phosphorus loadings to a waste water treatment plant by about 55%. A related study showed that phosphorus is not the factor which fully accounts for the ability of secondary treated domestic waste water to stimulate the growth of algae. Detergents in waste water do not seriously contaminate groundwater especially if aerobic treatment precedes discharge. Residues of anionic detergents have been found in fish and mollusks at levels considered safe for human consumption. Various toxicity studies have been performed on anionic detergents, sodium nitrilotriacetic acid (NTA) containing detergents, polyoxyethylated cationic and nonionic surfactants, and linear and branched alkylbenzene sulfonate (ABS). Lower levels of heavy-duty nonenzyme and enzyme type detergents were found to stimulate corn growth and increase yields, while higher application levels resulted in abnormal growth and decreased yields. Biodegradation studies have been performed on: Linear alkylate sulfonate (LAS) in a model extended aeration-type activated sludge system; branched chain nonylphenol ethoxylates in activated sludge; cationic surfactant acyldiethanolamine phosphate (ADAP) by fungus; NTA in a trickling filter plant, an extended aeration-type activated sludge process, septic tanks, oxidation pond systems and sapromat tests; and, Sulfopone in an activated sludge process. Removals of surfactants by ultrafiltration, flotation extraction, and activated carbon adsorption have also been investigated.

*Reviews, *Detergents, *Surfactants, *Waste water treatment, *Domestic wastes, Toxicity, Biodegradation, Linear alkylate sulfonates, Alkylbenzene sulfonates, Nitrilotriacetic acid, Phosphorus, Activated sludge, Trickling filters, Activated carbon

Sulfopone

J152
MARINE AND ESTUARINE POLLUTION,

Reish, S. J., Kauwling, R. J., and Mearns, A. J.

California State University,
Long Beach.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1617-1635, June, 1975. 1 tab, 210 ref.

The 1973-74 literature was reviewed for articles dealing with marine and estuarine pollution. Topics covered include: oil pollution; sludge dumping and dredging; bioassays; complex effluents; diseases and abnormalities; residues and related topics; microorganisms; and chemical and physical oceanography. A table is presented which lists the chemical residues reported for various marine organisms. The environmental effects, sources, and control of marine pollution, pollutant identification, and changes in benthic community structure and sediment composition are discussed.

*Water pollution, *Oceans, *Estuaries, *Reviews, Water pollution effects, Water pollution sources, Water pollution control, Oil pollution, Sludge disposal, Dredging, Industrial wastes, Chemical wastes, Heavy metals, Aquatic organisms, Bioassay, Oceanography

J153
ORGANICS,

Suffet, I. H., Friant, S., Marcinkiewicz, C., McGuire, M. J., and Wong, D. T-L.

Drexel University, Philadelphia, Pennsylvania, Department of Environmental Engineering and Science.

Journal of the Water Pollution Control Federation, Vol. 47, No. 6, p 1169-1241, June, 1975. 13 tab, 701 ref.

An extensive review of the 1974 literature on organics in water pollution (identification, analytical procedures, treatments, sources) is presented. Topics covered included: oxygen demand and organic carbon; detergents and surfactants; oil and grease; pesticides and related chlorinated hydrocarbon compounds such as chlorinated hydrocarbon pesticides, polychlorinated biphenyls, napthalenes and paraffins, organophosphorus pesticides, carbamates and ureas, herbicides, and other pesticides; and, organic analysis of water including waste water analyses, drinking water and natural water analyses, and analyses of humic acids, organic mercury compounds, plastics, plasticizers-phthalate acid esters, taste and odor compounds, organic acids, nitrogen compounds, carcinogenic compounds, and sulfur compounds. The following information was presented in table form: toxicity and biological effect of detergents, surfactants, and detergent builders on aquatic organisms; toxicity and biological effects of petroleum contaminants on aquatic organisms; toxic effects of chlorinated hydrocarbon biocides in aquatic organisms; residuals of chlorinated hydrocarbons in aquatic related organisms; residuals of chlorinated hydrocarbons in soils and sediments; photolysis studies of chlorinated hydrocarbons; toxic effects of PCB's on aquatic related organisms; summary of studies of environmental impact of pesticides; toxic effects of herbicides to aquatic related organisms; herbicide adsorption studies; photolysis studies of herbicides; collection methods for identification of trace organics in water; and, toxicological levels and effects of mercury.

*Water pollution, *Reviews, *Organic compounds, Water pollution sources, Water pollution control, Pollutant identification, Pesticides, Oil pollution, Detergents, Surfactants, Water analysis, Plastics, Toxicity, Environmental effects

J154
POLLUTION EFFECTS ON SURFACE WATERS AND GROUNDWATERS,

Young, R. H. F.

Hawaii University, Honolulu, Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1600-1610, June, 1975. 95 ref.

The 1973-74 literature dealing with the pollution of surface and groundwaters was reviewed. Topics covered included: nutrients in surface waters; runoff and waste discharges; groundwater pollution; land and subsurface disposal of waste water; heavy metals; radionuclides; biological contamination; thermal discharges; and models and indexes of water quality. Phosphorus and nitrogen studies were performed with regard to levels, relationship to productivity, sources, and control. Carbon chloroform extract, phenol, DDT, PCB, heavy metals, soil and grease, and coliforms are constituents of runoff and waste discharge. The toxicity of chlorine residuals to aquatic organisms was investigated. Hydrocarbons in sediments and the environmental effects of outboard motor subsurface exhausts were reported. Urban runoff and non-point sources received more attention than in previous years. Causes, effects, controls, and monitoring of groundwater pollution are discussed. Sources and toxic effects of heavy metals are reported.

*Water pollution, *Reviews, *Groundwater, *Surface water, Water pollution sources, Water pollution effects, Water pollution control, Nutrients, Phosphorus, Nitrogen, Heavy metals, Phenolics, Organic compounds, Urban runoff, Model studies, Toxicity, Aquatic organisms, Thermal pollution, Pesticides, Radioactive wastes

Non-point sources

J155
STANDARDS, ADMINISTRATION, AND SURVEYS,

Gross, S. P.

Delaware River Basin Commission,
Trenton, New Jersey,
Water Quality Branch.

Journal Water Pollution Control, Vol. 47, No. 6, p 1806-1820, June, 1975. 138 ref.

Articles published during 1973-74 concerned with standards, surveys, and administration for water pollution and water quality were reviewed. Research needs for the setting of standards include perspectives and limitations to criteria, protection of aquatic ecosystems, assimilative capacity, mixing zones, bioassays and biological monitoring, bioaccumulation and concentration factors, eutrophication, nuisance organisms, tastes and odors, heat and temperature, pathogens and microbial indicators, minerals and salts, metals, organic compounds, and radionuclides. Actual use of water quality standards in clean-up programs on various water bodies was reported. Two concepts of water quality management and regulation, effluent standards and water quality standards were compared. Administrative activities have included issuance of National Pollutant Discharge Elimination System (NPDES) permits, enforcement actions, and publication of reports, guidelines, standards, and regulations encompassing all phases of water pollution control and abatement. The first annual "National Water Quality Inventory" was published by the Environmental Protection Agency. A compilation of state estimates of costs to meet needs for publicly-owned waste water treatment facilities and collection systems equalled $350 billion. STORET, EPA's computerized information system for storing and retrieving water quality data, was discussed. Several water quality indexes were proposed. Waste water treatment processes and practices in other countries were examined.

*Water pollution, *Reviews, *Standards, *Administration, *Surveys, *Waste water treatment, Water quality control, Water pollution abatement, Water pollution control, Permits, Industrial wastes, Municipal wastes, Computers, Costs, Bioindicators, Bioassay, Heavy metals, Organic compounds, Pathogenic bacteria, Treatment facilities

J156
CLEARWELL QUALITY DOESN'T LAST,

Hash, L. J.

Water Department,
Sioux Falls, South Dakota.

The American City, Vol. 90, No. 5, p 56-57, May, 1975. 2 fig.

Problems in a water distribution system can be indicated by red water, cloudy water, and taste and odor complaints. These problems may be caused by bacterial action. The accumulation of flocculation of iron can be intensified by bacterial growth and can occasionally be dislodged during periods of high velocities in the mains. An undesirable taste similar to that of stagnant water can also be caused by an accumulation of bacterial growth. Depletion of oxygen or destruction of chlorine residuals can occur when certain species of bacteria are present. Accumulations of bacteria in unlined cast iron pipes can serve to inhibit or accelerate corrosion, depending on the extent and nature of the accumulation. Increased chlorination and lowered pH is an obvious answer to extensive bacterial growth. Organic carbon, nitrogen, and phosphorus are necessary for bacterial growth. Organic carbon appears to be the limiting nutrient in the distribution system. Aeration, ozonation, addition of potassium permanganate, or adsorption on activated carbon could accomplish the removal of a carbon source during treatment. Nitrogen and phosphorus sources should be added to water only after their assessment as potential bacterial growth stimulators. The same care should be taken prior to adding sulfuric acid as a pH control after softening to the finished water.

*Distribution systems, *Bacteria, Water, Odor, Taste, Conduits, Iron, Pipes, Corrosion, Chlorination, Aeration, Adsorption, Activated carbon, Nitrogen, Phosphorus

Organic carbon, Bacterial growth, Ozonation, Potassium permanganate, Bacterial growth stimulators

J157
RECENT DEVELOPMENTS OF INSTRUMENTATION, CONTROL AND AUTOMATION SYSTEMS FOR WASTEWATER TREATMENT SYSTEMS,

Kato, S., Kimbara, K., and Oto, T.

Hitachi Review, Vol. 24, No. 1, p 35-48, January, 1975. 22 fig, 5 tab, 31 ref.

A review of the development of modern waste water treatment and control systems in Japan is presented. This includes field type digital controllers as well as computer control systems with man/machine/process interfaces. Control systems for machinery and drive, with energy saving as a goal have been improved. Instrumentation being manufactured by Hitachi includes the large-bore electromagnetic flow meter, a sludge settling rate meter, a respiration rate meter, and a total organic carbon/total nitrogen analyzer. Minor control systems for unit operations of the activated sludge process are described. Such systems are a dissolved oxygen concentration/air flow control, a MLSS/return sludge volume control, and a sludge age/drawing volume of excess sludge control. Computer control systems have been designed for effluent quality control and for centralized supervision. Control of machinery and power consumption is effected by aeration blowers, and by pumps for waste water, rainwater, and sludge.

*Waste water treatment, *Computers, *Activated sludge, Control systems, Flow control, Analytical techniques, Instrumentation, Flow measurement, Sludge treatment, Pumps, Equipment

*Japan, Energy consumption

J158
DESIGN AND OPERATING CRITERIA FOR RURAL WATER SYSTEMS,

Goodwin, G. L.

Oklahoma State University, Stillwater,
Graduate College.

OWRR Research Report B-028-OKLA (1), May, 1975. 68 p, 27 fig, 4 tab, 16 ref, 3 append.

An analysis was made of the water usage in the Rural Water District No. 3, Payne County, Oklahoma. Customers were categorized on the apparent economic value of their residence and were classified as Class A, Class B, or dairies. The monthly usages of each of these groups were analyzed to obtain patterns of usage. The patterns of usage were then used to determine the values of daily demand and peak demand expected for type of user. There was a significant difference in the usage pattern for the three classes of customers. The average monthly usage per tap was 8768-19,138 gal for dairies, 4357-11,983 gal for Class A taps, and 2537-4160 gal for Class B taps. The average monthly usage per person ranged from 1424 to 2821 gal for Class A taps and from 989 to 1664 gal for Class B taps. Optimal design values for daily demand were 200 gal per Class B tap, 350 gal per Class A tap, 600 gal per Dairy tap, 12 gal per dairy cow milked, 90 gal per person for a Class B tap, and, 150 gal per person for a Class A tap. The optimal design values for peak demand were 1.3-1.8 gal per minute per Class A tap, and 0.6-0.9 gal per minute per Class B tap. The optimal period off-peak pumping time was from 10 p.m. to 7 a.m.

*Water distribution (applied), *Rural areas, Water delivery, Water demand, Water users, Water utilization, Domestic water, Dairy industry, Design criteria, Pumping, Water supply

J159
HOW WELL ARE WE HANDLING TOXIC WASTE?,

Surveyor, Vol. 146, No. 4326, p 19-24, May 2, 1975. 7 fig, 2 tab.

Pitsea, Essex County, England, became a site for industry to deposit waste materials due to the Deposit of Poisonous Waste Act of 1972. Following the Act the amount of waste arriving jumped from 11 million gallons per year to 35 million. A greater regionalization in toxic waste disposal is needed to reduce the increased site management and transportation risks inherent in waste disposal areas that are few in number. In 1973 a research program was begun by the Institute of Geological Sciences, Water Research Centre, and Hazardous Materials Service (Harwell) to study the behavior of hazardous wastes in landfill sites. Being investigated are the following: flow pattern in the unsaturated zone of rocks; refuse/hazardous waste/refuse sandwich interactions (wastes being metal hydroxide sludge, cyanide heat treatment waste, and oily waste); and pulverized refuse. Also, a short course run at six-month intervals is being given. The Warren Spring waste exchange is being operated in an attempt to recycle. There have also been proposed revisions of geological formation classification for the purpose of landfill site and assessment.

*Waste disposal, *Industrial wastes, *Municipal wastes, Landfills, Investigations, Toxicity, Leachate, Recycling, Legislation, Oily wastes

Toxic wastes, Refuse, England, Metal hydroxide sludge, Cyanide heat treatment wastes

J160
WATER RECLAMATION AND REUSE,

Kugelman, I. J., and English, J. N.

National Environmental Research Center,
EPA, Cincinnati, Ohio.

Journal Water Pollution Control Federation, Vol. 47, No. 6, p 1338-1344, June, 1975. 76 ref.

A review of the recent literature on water reclamation and reuse is presented. Discussion of reuse in water resources planning indicated a general feeling that detailed information on health effects of reused water is needed in order to gain public acceptance of reuse. Industrial applications of water reuse are greatly dependent on economic advantages. Industries which are developing processes to recycle water include pulp and paper manufacture, petroleum, metal finishing, photographic processing, and food processing. Other waste water reuse plans are in irrigation and groundwater recharge. Secondary effluent is returned to groundwater in Phoenix, Arizona, by being spread on infiltration basins; adjacent wells will pump the infiltrated water out of the ground for irrigation and industrial reuse. Domestic reuse possibilities include recycle of waste water for use as toilet flush water, treatment of laundry water, and future direct potable reuse of treated waste water.

*Reviews, *Water utilization, *Water reuse, *Water resources development, Industrial water, Irrigation, Economics, Potable water, Public health, Infiltration, Recycled water

Secondary effluents, Industrial reuse, Groundwater recharge

J161
PRESSURE CONTROL IN A MOUNTAIN AREA WATER SYSTEM,

Public Works, Vol. 106, No. 5, p 100-101, May, 1975. 1 fig.

The Crestline-Lake Arrowhead Water Agency, located northeast of Los Angeles in the San Bernardino mountains, draws water from the Feather River Aqueduct. It wholesales this water to 27 outlets serving 10,000 customers, and also acts as a fire service. During design of the system, it became apparent that to maintain a practical distance between hydrants, many hydrants would be placed in areas where the pressure (850 psi) would exceed the capabilities of the fire fighting equipment. Therefore, the agency built a test facility costing $27,000 to evaluate the capability of control valves needed to reduce pressures. Cavitation was observed below the valve rather than within it - 10 to 15 diameters downstream of the valve. A temporary energy dissipator was devised consisting of river rocks (3/4 to 1-inch) stuffed into a 4 1/2-foot long section of a 6-inch water main, with 1/4 by 1-inch steel bars welded across the end of the piece. With cavitation taking place in the dissipator, the rocks appeared to have been split in half. The rocks and bars were evaluated, and a permanent dissipator was designed and patented. The configuration of the energy dissipator can be changed to meet flow demand conditions. The tube-like device has been made in lengths of 18 inches to 4 1/2 feet, and is filled with steel balls furnace-welded together.

*Water pressure, *Mountains, California, Valves, Hydrants, Design, Energy dissipation, Water distribution (applied), Water delivery

Water system

J162
INTERACTIVE SIMULATION FOR WATER SYSTEM DYNAMICS,

Grigg, N. S., and Bryson, M. C.

Colorado State University, Fort Collins, Department of Civil Engineering.

Journal of the Urban Planning and Development Division, ASCE, Vol. 101, No. UP1, p 77-92, May, 1975. 6 fig, 2 tab, 10 ref, 2 append.

The method of simulation known as systems dynamics, developed by Forrester at the Massachusetts Institute of Technology, can be applied to basic problems in urban water supply. A water-supply planning study would proceed with the following steps: definition of goals; collection of data; study and formulation of alternatives; evaluation of alternatives; and, selection of a plan. The Fort Collins (Colorado) model, which considers population, water, land, and the municipal budget, is defined by the following level variables: population; water rates; water in storage; water funds available; value of the water system; water rights owned; debt; and, occupied land area. The model demonstrates how factors such as rate structure affect level variables, and includes a mixture of explicit (programmed) and implicit (operator-determined) feedback loops. The behavior of the system is obtained through an iterative set of calculations, each set representing changes that occur during a period of one year. Values of the level variables in one year are used as input to the calculations, which determine the changes that take place during the next one-year interval. It is concluded that application of an elementary system dynamics methodology to problems in urban engineering offers substantial promise wherever realistic data are available. It is expected that collection and interpretation of data will continue to be the most difficult part of such studies.

*Model studies, *Water supply, Planning, Population, Budgeting, Land, Rates, Cities

Systems dynamics, Urban engineering

801

J163
WATER PLANT GOES AUTOMATIC,

Kron, C.

Water and Wastes Engineering, Vol. 12, No. 5, p 59-61, May, 1975. 2 fig.

The Iowa City, Iowa, Municipal Water Treatment Plant has become completely automated as a result of its recent modernization program. The decision to computerize the entire facility was due to rapidly changing water conditions with widely varying seasonal conditions typical of mid-western rivers, presenting special treatment problems prior to distribution. To supply its 50,000 customers, Iowa City gets only 5% of its water from a deep well which requires only chlorination and settling before distribution. The remaining 95% is pumped from the Iowa River. A digital computer will control the following areas: high service pumps (starting and stopping the pumps in relation to system demand); rate of flow, by monitoring the clear well level and by calculating the rate of flow to maintain the clear well level; and operation of pumps at the river intake structure, to supply adequate water for maintaining the desired plant flow rate. Part of the computer program also controls the filter effluent valves. Chemical feed, skimming gates, backwash, and sludge blowoff are controlled by determining the quality of the raw water.

*Treatment facilities, *Automation, Rivers, Deep wells, Pumps, Flow rates, Intakes, Water quality control, Water treatment

Iowa City (Iowa) Municipal Water Treatment Plant, Iowa River

J164
AERATION UPGRADES RESERVOIR,

Harper, R. S.

Escondido Mutual Water Company, Escondido, California.

Water and Sewage Works, Vol. 122, No. 6, p 40-41, June, 1975.

A compressor-operated aeration system has been decreasing the hydrogen sulfide concentration and increasing the dissolved oxygen content in the Lake Wohlford reservoir in California since the mid-1960s. The installation consists of a Schramm Model 210 Compressor connected by a 2 in galvanized pipe to a 1 1/2 PVC pipe that reaches 40 ft deep into the lake at the hypolimnion. This pipe ends with 20 ft sections, each perforated with 30 holes to release the compressed air. The aeration system is designed to operate at 22 psig, with a volume of 210 cfm. Air leaving the openings forms into bubbles which rise to the surface. Oxygen is dissolved at the interface of each air bubble and its surrounding water. The mass of rising bubbles creates a boiling effect on the surface. Water, no longer supported by the jet, flows outward 360 degrees around the boil pattern. The dissolved oxygen picked up at the water/atmosphere interface is about equal to the amount assimilated from the compressed air bubbles. The major factors which determine the overall mixing time are the expanse of the compressed air column and the duration of the compressor operation. The boil column at Lake Wohlford is about 0.7 acres after a 30 hr compressor run. The aeration system has reduced the chlorine dosage necessary to treat the water for drinking, has reduced evaporation resulting in a saving of 35 acre feet of water, and has increased the fish population due to the improved dissolved oxygen content.

*Reservoirs, *Aeration, *Dissolved oxygen, Hypolimnion, Reservoir operation, Reservoir evaporation, Turnovers, Upwelling, Odor, Taste, Water treatment, Mixing, Hydrogen sulfide

J165
STUDIES OF PREVENTION OF WATER POLLUTION. III. ON THE BIODEGRADATION OF SYNTHETIC DETERGENTS,

Sakaguchi, O., Yokota, K., and Takashita, S.

Eisei Kagaku, Vol. 21, No. 2, p 51-54, 1975. 4 fig.

The biodegradation of synthetic and commercial detergents has been examined at various conditions. Domestic sewage was incubated at 30 degrees, to study the degradation of linear alkyl benzenesulfonate (LAS) and alkyl benzenesulfonate (ABS). Twenty ppm LAS degraded easily and was about 50% consumed after seven days under aerobic conditions, but was only slightly degraded under anaerobic conditions. On the other hand, the higher fatty acid ABS was easily biodegraded under both aerobic and anaerobic conditions after one day. Biodegradation of LAS was delayed in the presence of nutrients. When detergent-grown cells separated from domestic sewage were observed, they showed two optimal peaks of 2,3,5-triphenyltetrazolium chloride (TTC) reduction activities at pH 7.0 and 8.5.

*Biodegradation, *Detergents, Alkylbenzene sulfonates, Water pollution, Sewage, Municipal wastes, Aerobic conditions, Anaerobic conditions

J166
ON THE COMPARISON OF REVERSE OSMOSIS MEMBRANE PERFORMANCE,

Kunst, B., Arneri, G., and Vainaht, Z.

Institute of Physical Chemistry, University of Zugreb, Yugoslavia.

Desalination, Vol. 16, No. 2, p 169-177, April, 1975. 4 fig, 3 tab, 10 ref.

Methods of comparing the operational performance of different reverse osmosis membranes are analyzed. The inherent porosity of a membrane was shown to affect systematically the extent of concentration polarization at the high pressure side of the film. The development of a proposed method for determining the value of membrane flux needed to compare various membranes is documented. It was shown that the inherently more porous Batch 316- and 400-type reverse osmosis membranes do not show improved performances at the highest operating pressures (102 atm). This is due to the tendency of high pressure to close the small-size pores that are initially generated in these types of membranes. The pressure sensitivity of such membranes, caused by the increased concentration polarization above the more porous membranes, should be considered when comparing the performances of different reverse osmosis membranes.

*Reverse osmosis, *Membrane processes, Analytical techniques, Pressure, Porosity, Physical properties

Performance, Presure sensitivity

J167
ORGANIC RESIDUE IN A RECYCLED EFFLUENT, PART I,

Adams, V. D., Middlebrooks, E. J., and Nance, P. D.

Utah State University, Logan.

Water and Sewage Works, Vol. 122, No. 6, 82-84, June, 1975. 7 fig, 2 tab.

Use of recycled effluent from a waste water treatment facility, for flushing purposes has been proposed. Such a system consists of utilizing physical treatment in conjunction with a catalyzed hypochlorite generating waste water treatment process. One difficulty of this is the accumulation of organic compound residue in the recycled effluent. An investigation using sophisticated chemical detection techniques was carried out to identify the compounds that accumulated in recycled effluents at a package treatment plant such as for a recreation area. Total and inorganic carbon concentrations were measured; over 60 percent of the carbon was in the organic form. Ether and chloroform extractions were completed with the various peaks in the infrared and nuclear magnetic resonance spectra identified. Extractions were also made of houseboat effluent, obtaining a similar NMR spectrum. It was concluded that under the conditions used for sewage effluent treatment, the majority of the excreted nitrogen compounds should be oxidized to lesser components. Most organic species should be treated by chlorination. Some free radical chlorination should proceed on alkane species present in the effluent, with alkene type compounds to be readily converted by chlorine to saturated compounds containing two atoms of chlorine attached to adjacent compounds.

*Water reuse, *Waste water treatment, *Organic compounds, Chlorine, Analytical techniques, Chemical analysis, Carbon, Effluents

Physical treatment, Organic residue

J168
EPOXY RESIN APPLICATION AT SEWAGE WORKS,

Water and Waste Treatment, Vol. 18, No. 5, p 23, May, 1975.

The expansion of the Chicken Hall Water Treatment Works, Eastleigh, Hants, U. K., to ten 80 ft diameter concrete tanks to handle 600,000 gal of industrial effluent, and domestic sewage from a population of 62,000 was accompanied by a problem of algal growth. Algae had to be cleaned from tank channels and weirs daily by manual brushing. The application of an epoxy primer and topcoat based upon resins and curing agents has reduced the necessary cleaning to once a week by forming a smooth resin surface which prevents algae from attaching firmly. The resin incorporates a thixotropic agent to aid even application on vertical surfaces, a modified amine to facilitate curing at low temperature and in damp environments, and is reinforced with silica flour. The epoxy resin was trowelled onto the tank channel and weirs to a depth of 2 mm. The coating is self levelling which provides a smooth finish to reduce turbulence and surface abrasion. The fully cured topcoat is also highly resistant to leaching. A new polyester resin has been formulated for bonding PVC and is being used as the standard bonding agent for the Coplastix range of rigid PVC penstocks and valves. The polyester resin provides a means for bonding to PVC without the necessity of abrading or etching the PVC with solvents which could cause permanent softening of the PVC.

*Waste water treatment, *Sewage treatment, *Algal control, *Eposy resins, Treatment facilities, Construction materials, Maintenance

Polyvinyl chloride, Polyester resin

J169
GREEN BAY SELF-PURIFIES ALGAL NUTRIENTS,

Fitzgerald, G. P., Torrey, M. S., and Gerloff, G. C.

Water and Sewage Works, Vol. 122, No. 6, p 58-61, June, 1975. 2 fig, 4 tab, 15 ref.

The effects of industrial and municipal waste loadings on the nutrition of the algae along the Fox River at Green Bay, Lake Michigan, were studied. Tests of nutrient concentration in algal samples are used to evaluate the fate of pollutants in aquatic environments. It was proposed that significant reduction of the algal nutrients might be achieved if the removal of phosphorus from their effluents is implemented by major cities in the Great Lakes drainage basin. Sources of nutrients to Green Bay, water flow patterns, phosphorus, nitrogen, and iron concentrations, and bioassays of Cladophora populations were determined. A direct linear relationship was found between concentration of PO4-P and growth of algae in control cultures; addition of nitrogen and/or iron increased growth significantly. The growth of algae in Lake Michigan seems generally to be limited by available phosphorus during the algal growing season. In early winter, Green Bay, which uses tertiary treatment of municipal and industrial wastes, is effectively self-purified, and does not supply Lake Michigan with major quantities of algal nutrients. It was recommended that other Great Lakes areas apply similar phosphorus removal and self-purification practices.

*Algae, *Algal control, *Municipal wastes, *Lake Michigan, *Cladophora, *Nutrient removal, *Phosphorus, Industrial wastes, Drainage, Water purification, Tertiary treatment

Green Bay, Fox River, Algal nutrients

J170
USING HYDROGEN PEROXIDE FOR POLLUTION CONTROL,

Water and Sewage Works, Reference Number, p 186-188, April 30, 1975. 5 fig, 7 tab.

The compound hydrogen peroxide (H2O2) has several applications in pollution control. It has been used for odor control, reduction of bulking in the activated sludge process, for better settling of the mixed liquor suspended solids, and for the addition of oxygen to waste. Hydrogen peroxide itself is not a pollutant and leaves no toxic residues. Because an increasing number of municipalities and industries are utilizing this compound, some of its important physical properties are described. Tables reproduced from the FMC Corporation book entitled "Hydrogen Peroxide Physical Properties Data Book" provide information on: physical properties, measured in density of aqueous hydrogen peroxide solutions at zero degrees centigrade; physical properties measured in density of aqueous hydrogen peroxide solutions at 25 and 50 degrees centigrade; weight percent, mole fraction conversion and average molecular weight for hydrogen peroxide-water solutions; density of aqueous hydrogen peroxide solutions in degrees Baume; and the composition of particular decomposition products.

*Water pollution control, *Odor, *Activated sludge, *Physical properties, *Density, Aqueous solutions, Oxygen

*Hydrogen peroxide, Mixed liquor suspended solids

J171
SALINITY CONTROL AND FEDERAL WATER QUALITY ACT,

Bessler, M. B., and Maletic, J. T.

U.S. Bureau of Reclamation,
Denver, Colorado,
Water Quality Office, Division of Planning Coordination.

Journal of the Hydraulics Division, ASCE, Vol. 101, No. HY5, p 581-594, May, 1975. 6 fig, 1 tab, 17 ref, 1 append.

Salinity is considered as a chemical or mineral pollutant under the Federal Water Quality Act and is receiving increased attention in the western U. S. Salinity and the adequacy of basin water supplies is becoming a major economic issue in the Colorado River Basin. The overall planning strategy of the Colorado River Water Quality Improvement Program (CRWQIP) and some of its inherent limitations in meeting water quality goals are discussed. The Colorado River International Salinity Control Project is a comprehensive effort which demonstrates that salinity control planning must consider many complex interrelated factors from natural hydrologic variations and man-made changes to international relations and legislation reflecting public policy. The five categories of control that are presently being studied under the CRWQIP include: river system management; point source control; diffuse source control; irrigation source control; and, return flow utilization. If full water resource development is attained, then the point and diffuse source controls as identified in the CRWQIP will not be sufficient to meet salinity objectives established by the states and the EPA. Planning will be directed toward a Total Water Management concept which involves the following: integrating water resources management and land-use planning; planning and controlling of interrelated structures and physical features; examining and evaluating the existing systems, institutions, and legal requirements; displaying alternative plans to examine quality and quantity impacts within a river basin; and, deriving efficient operational and management modes for the river system.

*Saline water, Saline water intrusion, Rivers, Administration, Refining, Legislation, Water quality control, Water supply

*Colorado River Water Quality Improvement Program (CRWQIP), Salinity control, Federal Water Quality Act

J172
LARGE RURAL AREA ORGANIZES FOR POTABLE WATER,

Public Works, Vol. 106, No. 7, p 48-49, July, 1975. 1 fig, 1 tab.

A new rural water district, organized in Lorain County, Ohio, is one of the largest in the United States to be funded by the Farmers Home Administration (FHA). Formerly, costs of filling a private residential cistern were as high as $65 per month. In August 1973, the Rural Lorain County Water Authority was begun in order to integrate the area's water needs with the required financial and technical feasibility data. Public approval was gained by the distribution of a question-and-answer sheet concerning such matters as administration, project financing, size of mains, amount of water pressure to be provided, and amount of customers' water bills. Following this, hearings proceeded smoothly in the 16 political subdivisions. A program of construction was adopted to begin in August, 1975. Over 350 miles of pipe will be laid (over 360 sq mi) for a distribution system, including storage and pumping stations to bring treated water from ten miles away at the town of Avon Lake. Estimated costs of constructing the piping, service connections, valves, tanks, pump stations and other facilities are detailed; the total will be about $11.5 million. A projection of costs to the average Lorain county subscriber indicate that each will pay an initial rate of $9.00 per month for 2000 gallons of water; the next 2000 gallons will cost $3.50 per thousand gallons, with $3.00 per thousand gallons charged after that.

*Administration, *Water distribution (applied), *Water supply, Rural areas, Ohio, Construction, Cost comparisons, Pipelines, Pumping stations, Water costs

Authorities, Farmers Home Administration

J173
STUDIES ON FLOC-FORMING SUBSTANCES IN ACTIVATED SLUDGE. II. FLOC-FORMING ACTION BY THE VISCOUS SUBSTANCE EXTRACTED FROM ACTIVATED SLUDGE BY ALKALINE SOLUTION,

Sato, T., and Ose, Y.

Eisei Kagaku, Vol. 21, No. 2, p 55-59, 1975. 7 fig, 9 ref.

An investigation was made on floc-forming substances in activated sludge. Highly viscous substances were extracted from activated sludge 2 N and 0.1 N sodium hydroxide solution. Their abilities to form flocs were observed. Both of these alkaline extracts were seen to flocculate kaolin and E. coli suspensions at a pH below 3, but not near the neutral pH of 7, which is within the flocculating range for activated sludge. Because the substance extracted from activated sludge was insoluble in a strong acidity range, it was postulated that a correlation may exist between acid insolubility and flocculation.

*Activated sludge, *Flocculation, *Acidity, Escherichia coli, Analytical techniques

Floc-forming abilities, Alkaline solution extraction

J174
CORROSION CONTROL BY CATHODIC PROTECTION,

Field, E. G.

Corrosion Engineers Limited,
Great Britain.

Water and Waste Treatment, Vol. 13, No. 5, p 14-15, May, 1975. 1 fig, 1 ref.

Uses of cathodic protection for corrosion control in various areas of a treatment facility are described. Steel which is in contact with near neutral electrolyte is almost always subject to electro-chemical corrosion. Because current is generated where a difference in potential between two areas exists, corrosion is instigated at these anodic areas. The most effective way to completely inhibit this corrosion is to provide a current flow so as to prevent dissociation. Cathodic protection has been applied to pipelines laid in soils where other influences enhance the corrosion problem. It has also been used for buried external surfaces of storage tanks where coating is difficult. The United Kingdom Water Industry has not used cathodic protection for inhibiting corrosion on the internal surfaces of treatment tanks; in the United States, however, most treatment plants are painted and then cathodically protected to extend the length of the coating. Choices of cathodic protection system are sacrificial anode or impressed current and may be based on water analysis, including oxygen content, presence of chlorides, pH value, and total dissolved solids; on plant operation, including temperature and agitated and quiescent zones; and on the history of corrosion in particular areas of that individual facility.

*Treatment facilities, *Corrosion, *Cathodic protection, Pipelines, Tanks, Storage tanks, Water analysis

*Corrosion control

807

J175
MAN'S ACCELERATION OF HYDROGEOCHEMICAL CYCLING OF PHOSPHORUS: EUTROPHICATION OF INLAND AND COASTAL WATERS,

Stumm, W.

Swiss Federal Institute of Technology,
Zurich, Switzerland.

Water Pollution Control, Vol. 74, No. 2, p 124-133, 1975. 7 fig, 2 tab, 14 ref.

Human activities disturb the natural balance between hydrogeochemical cycles (phosphorus, carbon, nitrogen) in the ecosystem. Pollution results from this disturbance between the rate of production (photosynthesis) and destruction (respiration). This presentation discusses some relevant factors that regulate nutrient composition and productivity. An evaluation is made of the impact of civilization on terrestrial and oceanographic transformations of phosphorus. Also, simple models of phosphorus transformation are reviewed. In particular, correlations have been made between areal nutrient loading of lakes and their enrichment as a function of specific variables such as depth, retention period, and mixing. It is hoped that an understanding of such eutrophication may help in quantifying measures for lake restoration.

*Cycling nutrients, *Eutrophication, *Phosphorus, *Lakes, Ecosystems, Environmental effects, Hydrogeology

Nutrient loading, Lake restoration

J176
ENVIRONMENTAL ASPECTS--SACRAMENTO BANK PROTECTION,

Mifkovic, C. S., and Petersen, M. S.

Sacramento District Corps of Engineers,
California,
Water Resources Planning Branch.

Journal of the Hydraulics Division, ASCE, Vol. 101, No. HY5, p 543-555, May, 1975. 7 fig, 5 ref.

While flood control in the Sacramento River Valley has been practiced for several years, little concern was given to riparian vegetation and wildlife along the river banks. For this reason, many reaches of the Sacramento River where bank protection work was performed have now eroded, depleting berm areas and attacking the levees. This paper examines alternative design and construction practices that are under study by the Sacramento District, Corps of Engineers, to minimize adverse environmental effects. Some studies are being implemented on a test basis, such as the Wild and Scenic Rivers Study, which is evaluating environmental resources and interrelationships, physical characteristics of the river, water quality and use, recreation potential, land use, and social and cultural development. Possible modifications to preserve the environment which are being considered are: selective clearing and retention of vegetation with replacement at construction sites; restoration of berm areas; steeping the protected slope to preserve existing berm areas; requiring construction to be from the waterside with floating equipment; reducing the top of rock revetment to a high sustained flow level; and including recreation facilities at selected construction sites.

*Flood control, *Rivers, *Erosion control, *Watershed management, Wildlife conservation, Levees, Construction, Recreation facilities

Sacramento Valley

J177
SPECIFICATIONS FOR GRANULAR FILTER MEDIA,

Ives, K. J.

University College, London, England.

Effluent and Water Treatment Journal, Vol. 16, No. 6, p 297-305, June, 1975. 7 fig, 1 tab, 8 ref.

The use of coal, pumice, plastics, ceramics, garnet, ilmenite, alumina, and magnetite as filter media instead of sand, makes it desirable to compose a British Standard for granular filter media and to agree on methods used for testing filter media. A basis for a filterability test could be the Filterability Number F, which relates head loss, filter rate, average quality of filtrate during testing, quality of influent, and duration of test. The lowest value of F represents the best filterability. The use of sieves is the most practical grain sizing technique. Desirable size depends on the characteristics of the suspension to be filtered. Sieve size can be specified by the Hazen effective size. Shape can be defined in terms of sphericity: hydraulic diameter divided by sieve size. Sphericities of less than 0.6 would be unacceptable, since the grains would be too flaky and would settle in an unisotropic manner, resulting in rapid clogging. No unique optimal density exists. The density should be greater than that of water. An upper density limit is imposed by the conditions necessary for backwashing (greater density requires smaller size). Durability standards should relate to performance of the saturated media. The media should be whole grains, not cemented agglomerates. Solubility can be specified in terms of dissolution in acid. Leachate specifications may be based on World Health Organization International Standards for Drinking Water. Since surface physico-chemical properties cannot be significantly altered, it is not necessary to formulate specifications. Fall velocity does not need to be specified as it depends on the already specified parameter of size, shape, and density of the grains.

*Filtration, *Filters, *Waste water treatment, *Water treatment, Standards, Particle shape, Particle size, Sands, Sieves

Granular filter media specifications

J178
FOCUS-COMPREHENSIVE WATER RESOURCES MANAGEMENT,

Kohlhaas, C. A.

URS Corporation, New York, New York.

Water and Sewage Works, Vol. 122, No. 6, p 70-75, June, 1975. 1 fig, 7 ref.

The increasing demand for water supply and concern for pollution-free receiving waters require a comprehensive approach to the planning of water resources. A generalized water balance diagram is the key to comprehensive planning. Concepts emphasized include non-point source pollution problems. The diagram is based on the natural hydrological cycle that begins with precipitation, runoff, and evaporation to the atmosphere, leading to precipitation and a repeat of the cycle, and on the cycle of the use of water resources by man, their degradation through use, and their reclamation and ultimate reuse. The purposes of the diagram are: to provide general guidelines for water resources and environmental planning; to identify specific options for meeting water supply, waste disposal, and waste water reclamation goals; and, to provide for the evaluation of specific water resources alternatives. The generalized water balance diagram consists of several systems and subsystems: available supply system; surface stream system; evaporation; water supply and waste disposal system; water use-reuse system; groundwater system; reservoir system; subsystems of water supply sources; subsystem of storage; water treatment subsystem; waste water treatment subsystem; flood retention subsystem; recreational impoundment subsystem; industrial use subsystem; and, miscellaneous use subsystem. The use of the diagram is illustrated by several examples.

*Water resources, *Water resources development, *Administration, *Comprehensive planning, Water supply, Alternate planning, Alternative water use, Hydrologic cycle, Water supply, Water treatment, Waste water treatment, Project planning

Generalized water balance diagram

J179
THE FLOATING COVER: BEST WAY TO COVER A FINISHED-WATER RESERVOIR?,

Dallaire, G.

Civil Engineering, ASCE, Vol. 45, No. 6, p 75-79, June, 1975. 4 fig.

In a water distribution system, the finished-water reservoir should be covered to prevent water quality deterioration due to animal or bird droppings, dust and airborne contaminants, hydrocarbon exhausts, algal growth, and vandalism. About 10% of finished-water reservoirs are not covered, but use post chlorination or surveillance as a measure of amelioration. In cities where it was decided to cover their reservoirs, the choice was between a rigid (wood, concrete, or aluminum) or floating (Hypalon) cover. The floating cover has been chosen in Charleston, South Carolina; Philadelphia, Pennsylvania; and Chillicothe, Ohio; these systems are detailed. Advantages of the floating cover are: low initial costs; little maintenance; 100% resistance to seismic disturbances; rapid installation; elimination of evaporation of water or chlorine; elimination of algae growth as well as taste and odor problems; and, flexibility in that any size or shape reservoir can be covered with a floating cover. While a rigid cover has a longer expected lifetime, its installation and maintenance costs are higher. In a rigid cover system, there is an air space between the water surface and the cover which must be kept well ventilated; in the floating system, the cover moves with the water level, keeping the reservoir water clean, and preventing chlorine and water treatment chemicals from evaporating. Federal pressure and state financial support have been given to cities wishing to cover their finished-water reservoirs, and the floating cover method presents a viable alternative.

*Water distribution, *Water treatment, *Reservoirs, Water pollution control, Potable water, Construction materials, Installation, Maintenance, Chlorination, Legislation

*Hypalon floating cover,

J180
TROUBLE IN PARADISE,

Schwarz, H. E., and Eigerman, M. R.

Clark University,
Worcester, Massachusetts,
Department of Environmental Affairs.

Journal of the Hydraulics Division, ASCE, Vol. 101, No. HY5, p 603-612, May, 1975. 3 tab.

Overall planning problems for water quality control and waste water management are discussed. Social impacts are difficult to evaluate, and rather than a behind the desk data-gathering process, the Merrimack Wastewater Management Study was undertaken by interviewing local people in 15 surrounding towns and cities in this rural Massachusetts area. A matrix chart was used to record local issues and concerns, which was divided into vertical columns of "plan actions" and horizontal rows of "impact categories." The plan actions were: water quality; water quantity; water supply; collection systems; treatment residuals; planning and design; construction; land modification; capital cost funding; private abatement actions; and operations. The 18 impact categories included: population; commercial fisheries; employment; housing; recreation; land use; municipal services; municipal finances; political process; and public health. The study of the Merrimack Valley area was designed to inventory the local people for their problems and needs; to translate the messages received from the matrix into engineering terms so as to get feedback from the citizens as to the most important issues; to compare the matrices for all 15 surrounding communities; and to make and implement real engineering and management alternatives.

*Water quality control, *Water management (applied), Administration, Water pollution control, Massachusetts, Public benefits, Engineering, Environmental effects, Planning, Social impact

J181
OPERATION OF SEWER AND DRAINAGE SYSTEMS (BETRIEB VON KANALISATIONS-UND ENTWAESSERUNGSANLAGEN),

Frechen, B.

Technische Mitteilungen, Vol. 68, No. 5, p 164-166, May, 1975.

The monitoring, scavenging, operation, and maintenance of sewer and drainage systems are described. Sewer systems should be inspected after completion and should be regularly if not annually monitored by personal inspection or by cameras or closed circuit television. Cleaning is best accomplished by means of a high-pressure water jet. Sewer connections are scavenged by sludge suction or by emptying the collector buckets. It is suggested that sewer sections with multiple damages be replaced rather than repaired for economic reasons. It was also recommended that all monitoring, cleaning, and maintenance operations should be performed according to a fixed schedule.

*Sewers, *Sewerage, *Monitoring, *Cleaning, Operation, Maintenance, Waste water treatment, Sewage treatment

Television inspection, Sludge collector buckets

J182
NATION'S CAPITAL FACES CRITICAL WATER PROBLEM,

Civil Engineering, ASCE, Vol. 45, No. 6, p 58-61, June, 1975. 3 fig, 2 tab.

An overview of problems in water quality in the Washington, D. C. area is presented. In the past twelve years, 14 studies were conducted on how to store high flows for summer use and for flushing the estuary, whether or not to build dams and reservoirs to regulate flow, and how to treat the polluted estuary water of the Potomac River. Problems are bureaucratic as well as environmental. The area is owned by four states and the District of Columbia, which causes delay in any administrative decisions. Dams have been opposed because of land acquisition problems in populated areas. One estuary study is underway, whereby a one mgd demonstration plant will be built at the site of the Blue Plains Treatment plant to evaluate the possibility of making the polluted estuary water potable. While the Blue Plains facility has been expanded and improved in its tertiary stages, the system has had funding problems which have slowed its upgrading. Another new treatment plant that had been scheduled to be built, a 60 to 123 mgd facility in Dickerson, Maryland, has also had funding difficulties and opposition from environmentalists. A pessimistic feeling was stated about the overall progress in public water treatment for the Middle Atlantic Region by the Interstate Commission for the Potomac River Basin.

*Potable water, *District of Columbia, *Water quality control, Water distribution (applied), Water management (applied), Estuaries, Environmental effects, Treatment facilities, Costs

Potomac River, Blue Plains Treatment facility, Funding

J183
HOW BAD IS OUR TAP WATER?,

Water and Sewage Works, Reference Number, p R114, R119-R120, April 30, 1975.

The Bureau of Water Hygiene, Environmental Health Service of the U.S. Public Health Service conducted a national Community Water Supply Study (CWSS) during 1969 in eight geographically distributed Standard Metropolitan Statistical Areas and the State of Vermont. The study included 969 water supply systems serving about 18.2 million people. It was designed to assess the status of potable water quality, water supply system facilities, and bacteriological surveillance programs. The principal findings of the study are presented. The results of the study led to eleven specific recommendations; these are also presented. Some of the recommendations include: research to determine the influence of residual organics on the development of tastes and organism regrowth in distribution systems; research to understand what causes problems of appearance or taste in an otherwise safe drinking water; development of a more practical technique for bacteriological surveillance; development of new analytical procedures to tailor treatment to solve a specific taste or odor problem; engineering research to simplify and lower the cost of reducing the concentration of fluorides and nitrates and other inorganics; development of a continuous monitor for trace metals and corrosion products; monitoring of pressure in strategic locations in water systems; improvement of water systems by installation of adequate pumps, reservoirs and backflow prevention devices; and, enlargement of existing water treatment plant personnel training programs.

*Water treatment, *Facilities, *Potable water, *Water quality control, Treatment facilities, Personnel, Research and development, Surveys, Public health, Tastes, Odors

*Community Water Supply Study

J184
THE FEDERAL CONSTRUCTION GRANT PROCESS FROM A(BILENE) TO Z(ANESVILLE),

Rhett, J. T.

Water and Sewage Works, Reference Number, p R20, R22-R24, R27-R28, April 30, 1975. 5 fig.

The ground rules for the investment of public funds for sewers and treatment facilities are primarily set forth in the regulations published in the Federal Register in February of 1974. However, the procedural requirements are only broadly sketched. The step by step activities of applying for federal funds are explained in this article. A rough outline of each step is presented in flow chart form. The steps include: preapplication activity; step one or facility planning which takes from 6 to 12 months; step two or facility design which takes from 6 to 12 months; step 3 or construction which takes from 2 to 4 years; and operation and maintenance which continues for the plant life or 25 to 30 years. The following types of Federal aid are available: grants for various planning activities; technical assistance, especially for facility design and construction and for enforcement; technical information from Federal research, demonstration and monitoring; training for State and local personnel; an environmental Financing Authority to help local governments raise their share of the costs of treatment facilities; and, a larger Federal share of costs to a uniform 75 percent.

*Waste water treatment, *Facilities, *Financing, *Government finance, Grants, Local governments, State governments, Legislation, Costs, Planning, Federal Water Pollution Control Act

PL 92-500, Federal Water Pollution Control Act Amendments

8/2

J185
ESTIMATING INDIRECT COST OF URBAN WATER USE,

Lawrence, C. H.

Koebig and Koebig, Incorporated,
Los Angeles, California.

Journal of the Environmental Engineering Division, ASCE, Vol. 101, No. EE4, p 517-553, August, 1975. 3 fig, 4 tab, 21 ref, 1 append.

A simplified composite graphical representation for the estimation of indirect costs of urban water use is presented. The graphs were developed from a literature search of past investigations of quality-related cost effects. The estimation technique was used during the preparation of the California Water Quality Control Plan for the Los Angeles River Planning Area Basin 4B, a large urban area with multiple sources of local and imported water supply. Estimating curves are presented to assist in the determination of the economic impact upon water consumers of mineral quality of water as shown by the parameter total dissolved solids (TDS). A total impact cost curve for urban consumers, both industrial and nonindustrial, was developed for a range of TDS between 200 mg/liter and 800 mg/liter and a range of total hardness (TH) between 100 mg/liter and 400 mg/liter assumed to be uniformly one-half of the value of TDS. The slope of the total impact cost curve is the penalty cost, and is expressed in dollars/acre-foot per 100 mg/liter TDS. The major components of the total impact cost curve are domestic plumbing, domestic water heaters, municipal waterworks equipment, industrial water treatment, and all domestic and commercial measures performed to alleviate TH. Ways are presented to modify the total impact cost curve to reflect local conditions where they may be significantly different from those assumed for the curves presented. The curves must be considered as guides, not as absolute values, and should be used in relation to the local conditions.

*Water utilization, *Water demand, *Water costs, Indirect costs, Water supply, Cities, Graphical methods, Dissolved solids, Hardness (water)

Total dissolved solids, Total hardness

J186
FINLAND'S CLEANUP CAMPAIGN,

Josephson, J.

Environmental Science and Technology, Vol. 9, No. 8, p 710-711, August, 1975.

The International Bank for Reconstruction and Development has granted a 15 yr loan of $20 million to finance a water pollution control program in Finland. This is the first pollution control loan ever granted by the World Bank. The water consumption and waste water production per capita in Finland are among the highest in the world, due to the large forest products and pulp and paper industries. Water protection is generally regarded as having the highest priority in the field of environmental pollution control in Finland. Finnish authorities spend about $56 million/yr on municipal waste water treatment. Within the next five years, 90% of the municipal waste water should be effectively cleaned. Water use and cleanup in Finland are regulated by its Water Act of 1961, which prohibits blocking, changing, or spoiling water courses without a permit. The National Board of Waters is administering a cleanup program that stresses BOD7, phosphorus, and nitrogen. The NBW conducts a monitoring program for discharges and ambient water quality. About 15 consulting firms are approved by the NBW to perform monitoring work for individual industries. The only environmental standards in Finland are those for water. An Air Protection Act and a Noise Abatement Act are being drafted by the Ministry of the Interior's Division for Environmental Protection. A Waste Management Act is being drafted. Laws concerning oil damages, environmental poisons, and biocides are already in force. Projects to recover and use waste heat from industry to provide space heating for buildings are examples of Finland's philosophy that the more completely fuel, materials, and heat are used, the less waste matter and energy are left to pollute.

*Water pollution control, *Water pollution abatement, *Legislation, *Financing, Pulp and paper industry, Biochemical oxygen demand, Phosphorus, Nitrogen, Industrial wastes, Municipal wastes, Energy, Monitoring, Water quality control, Standards

*Finland

J187
LINING OF STORAGE RESERVOIRS AND LAGOONS—THE LATEST TECHNIQUES IN INSTALLATION AND JOINTING,

Coulson, J.

Water Services, Vol. 79, No. 952, p 235-237, June, 1975. 4 fig, 2 tab.

Synthetic rubber membranes for lining permanent reservoirs and lagoons have been used recently. Three different rubber materials which can be efficiently jointed and installed are Butyl, Hypalon, and EPDM. All three must have been manufactured to correct specifications; must have been satisfactorily fabricated into large sheet sizes under factory-controlled conditions, using correct jointing techniques for their particular product; and must have installation and site jointing carried out by skilled and fully trained operators. Butyl and EPDM are discussed in detail; in terms of weathering, chemical properties, permeability, and mechanical resistance, these materials are strong and long-lasting. In order to construct a structurally sound reservoir, however, it is necessary to follow recommendations for the embankment and reservoir base. The substrate must be smooth; efficient under-draining systems must have been built before addition of the membrane; and precautionary measures must be taken if any possibility of natural gas leakage exists. Both Butyl and EPDM are factory-made in sheets and vulcanized together by the use of heat pressure and an uncured tape which is placed between the sheets before heat and pressure are applied. Sheets may be jointed on site, and must be properly anchored into a reservoir. Hypalon may be supported or unsupported and is used in a scrim-supported form to waterproof lagoons or reservoirs. Hypalon is the least affected by ozone or by ultraviolet light.

*Synthetic rubber, *Reservoirs, *Lagoons, Installation, Joints (connections), Construction materials, Linings

*Jointing, *Butyl, *EPDM, *Hypalon, Reservoir linings

J188
CONTROL OF WATER QUALITY IN TRANSMISSION AND DISTRIBUTION SYSTEMS,

Rossie, W. L., Jr.

Roanoke County Public Service Authority, Salem, Virginia.

American Water Works Association Journal, Vol. 67, No. 8, p 425-427, August, 1975. 7 ref.

Water utility operators should be able to understand and anticipate stresses on a water distribution system. To control possible adverse effects from such stresses, the operator must prevent exposure, plan for emergency, discover stresses involved and modify conditions with this information, and, understand the interrelationship of variables and how to control them. The external environmental stresses that affect the internal environment of a distribution system include: insufficient treatment at point of procedure; open reservoirs; new construction; line breaks; cross connections; and, disaster operations. Each of these stresses is discussed. Monitoring of a water supply is very important. Tests for alkalinity, taste and odor, pH, turbidity, bacteria, chlorine residual, pressure readings, color, carbon dioxide, hardness, iron, and manganese should be performed to provide a routine check on the quality of water and background values. The use of baseline maps to plot background data quickly identifies abnormal readings that require more investigation. It is concluded that a distribution system is a living functional unit subject to stresses. Quality in design and construction and protective measures depend on quality materials and personnel. Adequate protective means are vital for stabilized operation and quality water in distribution systems.

*Water distribution (applied), *Distribution systems, Water conveyance, Water quality, Baseline studies, Monitoring, Personnel, Operation and maintenance, Stress

J189
USE OF A MOBILE LABORATORY FOR POLLUTION DETECTION,

Gardiner, E. R., and Bays, L. R.

Water Treatment and Examination, Vol. 24, Part 2, p 120-131, 1975. 1 ref, 1 append.

The function of a vehicle for pollution detection in rivers is discussed. This mobile laboratory has been designed for immediate action in the case of pollution and not as a replacement for existing fully-equipped laboratory facilities. Since the development of a Gross Pollution Detector by the Severn River Authority, an increased number of warnings should be given, and it is hoped that the mobile laboratory will facilitate faster identification of point source pollutants. The mobile laboratory should be able to arrive at a site, take a sample for immediate analysis and one for a retention and return to the main laboratory, place two guppies in a portion of the sample for observation, and run several analyses such as odor, visible pollution, pH, temperature, dissolved oxygen, organophosphorus, organochlorines, and heavy metals. In two cases cited, the mobile laboratory was able to detect and trace the source of pollution discharges within two to three hours of dispatch. The specific laboratory methods employed by the mobile unit to detect phenols, arsenic, ammonia, heavy metals, lead, copper, zinc, hexavalent chromium, cadmium, cyanide, thiocyanate, organophosphorus compounds, organochlorine compounds, and herbicides are outlined.

*Pollutant identification, *Rivers, *Facilities, Phenols, Heavy metals, Analytical techniques, Laboratory equipment, Water pollution control

*Mobile laboratory, Gross Pollution Detector, Severn River Authority

J190
EVALUATION OF STATE DRINKING-WATER-QUALITY SURVEILLANCE PROGRAMS,

Taylor, D. H., and Hutchinson, G. D.

Office of Water Programs, Environmental Protection Agency, Region IV, Atlanta, Georgia, Water Supply Branch.

American Water Works Association Journal, Vol. 67, No. 8, p 428-431, August, 1975. 5 tab, 11 ref.

The important water supply conditions found in the States of Tennessee, Kentucky, Georgia, and Florida were summarized. The state water supply programs that provide for public health and engineering surveillance were also characterized. Three general classes of water supply systems were identified: community water systems; small community water systems; and, private, individual systems. A cross-section of the water supply field in each state was selected for study. The effectiveness of each state's water supply program was determined to a large extent on the bases of potable water quality, adequacy and condition of water system facilities, and water supply surveillance. The data showed great similarity between the status of the water supply field in the four states. Public health surveillance in the four states was not adequate to ensure continuous, safe drinking water. Lack of engineering inspection of system facilities was another common failure. Water system operation was found to be deficient in all states evaluated. Those facilities staffed with trained and certified operators were better water systems. Failure to maintain a chlorine residual throughout the distribution system was a common problem. It is concluded that the state legislatures, the administrative levels of state government, and the water supply field need to make strong commitments to restore and widen the margins of safety that water supplies provide in the southeast U.S. Safe and adequate water supplies will depend on the use of higher water utility service standards and regulation, surveillance, and enforcement by public environmental protection control agencies.

*Water supply, *Water quality, *Water quality control, Potable water

J191
HIGHER PROFITS VIA ADVANCED INSTRUMENTATION,

Liptak, B. G.

Liptak Associates, Stamford, Connecticut.

Chemical Engineering, Vol. 82, No. 13, p 152-158, 160, 162, June 23, 1975. 9 fig, 2 tab, 16 ref.

In most chemical process plants, is is possible to increase production by about 20% by updating the instrumentation. A waste water treatment plant is considered in the example given but the approach used for systems evaluation and cost-benefit analysis can be applied to any other type of plant. Each of the main unit-operations found in a typical industrial or municipal waste water treatment plant is briefly reviewed with respect to instrumentation. The purposes of control systems are described and the traditional methods of instrumentation are compared with the capabilities of more-advanced control systems. Advanced controls include feedforward, multivariable, adaptive or optimizing systems. Before evaluating the advanced controls, the conventional loops must be fully utilized. Whenever a new control strategy is suggested, a cost-benefit analysis should be performed. This analysis should identify the economical and other benefits to be gained from the new control system, and in addition should present the associated capital and operating costs.

*Waste water treatment, *Treatment facilities, *Control systems, *Instrumentation, Cost-benefit analysis, Costs

*Advanced control systems

J192
AN EVALUATION OF WATER REUSE FOR MUNICIPAL SUPPLY,

Dworkin, D., and Baumann, D.

Southern Illinois University,
Carbondale, Illinois.

December, 1974. 266 p, 31 fig, 33 tab, 2 append. ADA 005 053.

Because of an increased demand on municipal water supply systems, reuse as an alternative water source has been considered. Reuse was defined as any additional application of waste water, including inadvertent and unplanned withdrawal and use of water from a river with an upstream discharge, directed and planned secondary treatment, or use of effluents for irrigation, recreation, or industry. An evaluation was made as to whether recycling renovated waste water could be an acceptable and economically efficient alternative. An investigation was made to identify the opinions of state public health officials and consulting engineers toward the practicability of using renovated water. A simulation model as applied to the Colorado Springs, Colorado, water supply system is detailed. Alternative plans, providing for reuse only when required were suggested. Manipulation of water supply and water demand was discussed and the public acceptance or rejection of using renovated water was debated.

*Water supply, *Water demand, *Municipal water, *Water reuse, *Waste disposal, Potable water, Waste water treatment, Recycling, Effluents, Public health, Economics, Simulation, Planning

Colorado Springs (Colo)

J193
REVERSE OSMOSIS OF TREATED AND UNTREATED SECONDARY SEWAGE EFFLUENT. APPENDIX A-2, APPENDIX A-6,

Boen, D. F., and Johannsen, G. L.

Eastern Municipal Water District,
Hemet, California.

January, 1975. 42 p. PB 239 354.

Two appendices have been published to complete the report, "Reverse Osmosis of Treated and Untreated Secondary Sewage Effluent, EPA-670/2-74-007". These are pH's Reverse Osmosis Units Feed and a Complete Printout Summary for the Eastern Municipal Water District's reverse osmosis tests conducted between March, 1970, and June, 1971. The computer data provide information in monthly statistical summaries of pressure, flow, conductivity, percent rejection, and flux. The main portion of the report defined fundamental abilities, requirements, and limitations of reverse osmosis when applied to secondary sewage effluents in various quantities; these appendices support the details of the main text.

*Reverse osmosis, *Data collection, *Computers, *Sewage treatment, *Waste water treatment, Effluents, Statistics

*Appendices, Secondary treatment

J194
ASSESSMENT AND DEVELOPMENT PLAN FOR MONITORING OF ORGANICS IN STORM FLOW,

Molvar, A., and Tulumello, A.

Raytheon Company,
Portsmouth, Rhode Island.

December, 1974. 88 p, 10 tab, 20 ref. PB 238 810.

A method for assessing the organic content of incoming combined sewage during storm periods is necessary to permit the choice of selecting or programming overflows. The ultimate objective of this study was to design a device for the automatic and rapid on-site monitoring loading of storm and combined sewer flows. Evaluation of the instrumentation necessary for a reliable Total Organic Carbon (TOC) measurement indicated that the best system would be one based on total oxidation of sewage and infrared detection of the carbon dioxide. Although no commercially available automatic monitoring system is suitable for storm water service, it is believed that most of the components to build such a system are available. Tests are being conducted to establish sample processing, modifications on the engineering model, and accumulation of the continuous monitoring data on TOC content of storm and combined sewers.

*Storm runoff, *Overflows, *Monitoring, Organic compounds, Infrared radiation, Sewage disposal, Analytical techniques, Storm water, Rivers, Automation

*Total Organic Carbon (TOC)

J195
INTERCEPTOR SEWERS AND SUBURBAN SPRAWL: THE IMPACT OF CONSTRUCTION GRANTS ON RESIDENTIAL LAND USE. VOLUME I, ANALYSIS,

July 31, 1974. 191 p. PB 236 477.

A study was conducted in the summer of 1974 to consider the relationships between interceptor sewer construction financed by the Environmental Protection Agency and residential development patterns in rapidly growing communities. A statistical analysis of data from fifty-two interceptor projects was made and case studies for eight local projects with high excess capacity and the largest proportion of vacant developable land in the service area were analyzed. A discussion is given of major interceptor planning and land policy issues, with recommendations for changes in EPA procedure based upon policy analysis. These recommendations included: withholding of Federal funds for excess capacity; re-evaluation of interceptor staging of project design in rapidly growing areas; application of realistic standards for per capita flow; improvement of population forecasting techniques; consideration of environmental effects of interceptor-induced land use; and publicity of community costs and benefits of interceptor-induced growth so as to increase public participation in the planning process.

*Interceptor sewers, *Construction, *Environmental effects, Federal project policy, Design, Land use, Land management, Administration, Water resources development, Sewerage

*Public policy analysis, Federal funding, Sewer construction, Residential development

J196
IDENTIFICATION OF OBJECTIONABLE ENVIRONMENTAL CONDITIONS ASSOCIATED WITH CONFINED DISPOSAL AREAS,

Harrison, J. E., and Chisholm, L. C.

Arthur D. Little, Incorporated,
Cambridge, Massachusetts.

September, 1974. 134 p, 24 fig, 15 tab, 108 ref, 3 append. ADA 000 895.

Four on-site investigations at the United States Army Engineering District areas of Mobile, Portland, Norfolk, and Detroit were conducted, related to objectionable conditions associated with confined disposal of dredged material. Problems involve: conditions associated with disposal area ineffectiveness, such as dike failures; conditions associated with biological, chemical, or physical changes caused by the disposal area; and issues associated with site selection such as ecological effects and changes in land management and use. Public attitudes toward confined disposal appear to be related to past experiences in their particular regions. Current technology is able to deal with the prevention of dike failure, seepage, channelization, and dike erosion, but is not able to solve the problem of standing water in disposal areas. Ecological issues have been centered upon the use of wetlands as disposal sites and the ultimate use and control of such areas. It was suggested that alternative disposal procedures be implemented, such as pumping inland, to avoid disruption of ecologically-sensitive wetland areas.

*Waste disposal, *Environmental effects, Land use, Land management, On-site investigations, Public rights, Dikes, Wetlands, Land use

Land application, Dredged material

J197
FORECASTS OF THE EFFECTS OF AIR AND WATER POLLUTION CONTROLS ON SOLID WASTE GENERATION,

Ralph Stone and Company, Incorporated,
Los Angeles, California.

EPA-670/2-74-095b, December, 1974. 799 p, 41 fig, 242 tab, 440 ref, 4 append.

The effects of air and water pollution treatment measures on the generation of solid wastes were evaluated. The solid wastes from pollution control were identified for the following sectors by their original air or water pollutant constituents and the treatment process employed: animal feedlots; mining and milling; meat and dairy products; canned and preserved fruits and vegetables; grain industry; paper and allied products; chemicals and allied products; petroleum extraction, refining, and transportation; cement manufacturing and structural clay; blast furnace and basic steel industries; iron foundry and ferroalloy industries; primary and secondary smelting and refining of nonferrous metals; electric power plants; sewerage; and hazardous solid waste residues. The wastes were categorized by type and by location (rural or urban). Total solid wastes from pollution control activities were estimated for 1971 and projected for 1975, 1980, and 1985. The major air pollutants that generate solid waste residues when controlled are particulates and sulfur oxides. The major water pollutants capable of generating solid waste residues when controlled are suspended solids, dissolved solids, and biological oxygen demand. Some of the commonly-used wet process air pollution treatments also generate suspended solids which add to the total water pollutant load. Acids in water form solid wastes when inert salts are formed by their neutralization or precipitation. Urban runoff is a significant source of pollution.

*Waste water treatment, *Solid wastes, *Industrial wastes, *Sewerage, Pollution abatement, Water pollution control, Air pollution, Suspended solids, Dissolved solids, Biochemical oxygen demand, Water pollution sources

J198
WATER QUALITY STUDIES,

EPA-430/1-74-007, May, 1974. 446 p.

This publication is a training manual designed for persons having responsibilities for planning and working in water pollution surveys. The chapter on sources of pollutants covers the pollutional characteristics of domestic waste waters, the sources and effects of industrial wastes, the influence of land runoff on water quality, irrigation return flow and agricultural runoff, and an overview on thermal pollution. Planning and conducting water quality surveys is explained in terms of organizing a stream survey, organizing a lake or impoundment survey, flow measurement, tracing natural water, sampling, sample handling, bacterial sampling, and the role of the bacteriologist in water quality surveys. The section on data handling and reporting includes: introduction to statistics; presentation of data; presentation and interpretation of bacteria data; preparation of survey reports; and the EPA Stor.. system. The aquatic environment, the identification of aquatic organisms, using benthic biota in water quality evaluation, biological field method, special applications and procedures for bioassay, and aquatic organisms of significance in pollution surveys are covered in the section on aquatic biology. The chemistry section explains the common water analysis tests. Bacteriological indicators of water pollution, analysis of coliform and fecal streptococcus groups, determination of bacterial pollution, and membrane filter techniques are discussed in the section on bacteriology. Dissolved oxygen and oxygen relationships are the topic of another section. Aerial reconnaissance in pollution surveillance and case preparation and courtroom procedure are also discussed.

*Water pollution control, *Water quality control, *Training, *Surveys, Water pollution sources, Bioassays, Bacteria, Bioindicators, Chemical analysis, Water analysis, Analytical techniques, Statistics, Aquatic life, Data collections, On-site data collections

Water pollution surveys, Training manuals

J199
STREAM POLLUTION ABATEMENT BY SUPPLEMENTAL PUMPING,

Reh, C. W., and Sadler, W. E.

City of Richmond, Virginia, Department of Public Utilities.

EPA-670/2-75-035, February, 1975. 108 p, 39 fig, 5 tab, 17 ref.

A major structure (a Supplemental Pumping Station), and several ancillary structures were added to the Richmond, Virginia, Wastewater Treatment Plant to achieve the project objective of no bypassing while a new grit chamber was being connected ahead of the existing Main Pumping Station. The Supplemental Pumping Station was constructed by sinking a two-compartment, sheet steel cofferdam around an existing 72-in concrete sewer and rearranging the influent sewer flow pattern so that the sewage was redirected to the site of the Supplemental Pumping Station. Redirection of the sewage flow was effected by the reconstruction of a junction chamber and by the insertion of a specially designed removable bulkhead. The project demonstrated that it is possible to cut in a major sewage treatment plant addition without bypassing raw sewage. If no special provisions have been made in the existing works or new facility design for additions without bypassing, special design will be required to achieve the no bypassing objective. Pumping units of standard design can be used. Chosen pumps were variable speed motor driven vertical centrifugal pumps. The time for design and construction of so-called temporary facilities is likely to approach that required for conventional facilities. This project required 36 months. The cost of the supplemental pumping station and appurtenant work was $900,000.

*Waste water treatment, *Bypasses, *Treatment facilities, *Pumping plants, Construction, Costs, Pumps, Sewage treatment

J200
ENVIRONMENTAL SURVEY OF TWO INTERIM DUMPSITES-MIDDLE ATLANTIC BIGHT. SUPPLEMENTAL REPORT,

EPA 903/9-74-010B, October, 1974. D. H. Lear, editor. 105 p, 30 fig, 6 tab, 28 ref.

Supplemental data from an environmental survey of two interim dumpsites in the Mid-Atlantic Bight are reported. Dissolved and particulate organic carbon accumulations were not found in the water column studied. Dissolved and particulate organic carbon accumulations are probably dependent on time of latest release and are also a cumulative function of time. No patterns of distribution in the water column were observed for particulate and dissolved iron, in spite of the weak thermocline. Statistical treatment of the data shows that metals disposed of in the oceans accumulate in the tissue of benthic organisms in quantities roughly proportional to the amounts dumped, that certain metals, such as vanadium and cadmium, are dumped in such quantities in one of the two sites studied such that they may be used as tracers for that dumpsite, and that the effects of these dumped materials are spread over a large undetermined area. Zooplankton populations at the sample locations showed no effects of stress.

*Water pollution effects, *Waste disposal, *Oceans, Environmental effects, Surveys, Benthic fauna, Iron, Heavy metals, Cadmium, Mollusks, Zooplankton

*Ocean dumping, Vanadium

J201
FINAL ENVIRONMENTAL IMPACT STATEMENT. VALLEY FORGE AREA WASTEWATER TREATMENT FACILITY, CHESTER COUNTY, PENNSYLVANIA,

Environmental Protection Agency, Region III, September, 1974. 426 p, 15 fig, 48 tab, 21 plates, 10 append.

An administrative action was taken by the Environmental Protection Agency involving the granting of financial assistance for the construction of a 8 mgd waste water treatment facility and related sewage collection system. Several municipalities in the area of Valley Forge, Pennsylvania, will receive construction grants as dictated in the Federal Water Pollution Control Act Amendments. This final Environmental Impact Statement (EIS) details the climatology, topography, hydrology, geology, man-made environment, air and water quality, population, and land management characteristics of the area serviced. The proposed facilities were designed to meet the waste water treatment needs for eight areas in Chester County as projected to the year 1985, and to alleviate public health hazards, improve water quality, and permit orderly growth patterns in the area. Evaluations were made of several alternatives including individual treatment processes and sewer line locations. Processes such as incineration, landfilling, landspreading, and spray irrigation were also considered. Included in this final EIS are a list of Federal, State and local agencies from which comments on the Draft EIS had been received, a detailed glossary, and 21 maps of the region. Appendices are included, referring to: the history of the proposed project; letters and petitions from residents; designated historical and archaeological sites; existing environmental controls; lists of area industries; and a summary of a Public Hearing held on January 10, 1974.

*Administration, *Treatment facilities, *Waste water treatment, Sewers, Federal Water Pollution Control Act, Water quality control, Environmental effects

*Construction grants, Environmental Impact Statement

J202
DESALTERS SOW SEEDS FOR SAUDI INDUSTRY,

Chemical Week, Vol. 117, No. 7, p 57-58, August 13, 1975.

Three dual-purpose desalination and electric generating plants have been planned for Saudi Arabia. A 50 mgd, 500-mw plant in Jedda on the Red Sea is being designed by a British firm, while two plants in the Eastern province, a 30 mgd, 300-mw plant at Al-Jobail and a 5 mgd, 50-mw plant at Al-Khafji, are being designed by a United States corporation. A conventional desalination method of multistage flash evaporation will be employed. While this technique requires a large amount of steam to make fresh water, the hydrocarbons necessary for producing steam are plentiful in Saudi Arabia and the need for water is crucial. By integrating the desalting plants with the production of electrical power, the fresh water production costs will be only 12 cents per cu m. The actual engineering, designing, and construction of the three plants will cost $15 billion and contracts will be divided into packages for bidding. Among these packages are: a power plant, including the steam boiler, site preparation, intake and outfall for the plant; living quarters for workers building the plant; and outside facilities such as power transmission. Additionally, Saudi Arabia has provided $3.5 million to organize a research center to study seawater desalination and related problems such as corrosion.

*Water treatment, *Desalination, *Treatment facilities, Design, Powerplants, Sea water, Electrical engineering

J203
COMMON FUNDAMENTALS IN WATER- AND WASTEWATER TREATMENT,

Benedek, P., Bulkay, L., and Vallo, S.

Vizugyi Kozlemenyek, No. 2, p 210-223, 1975. 8 tab, 3 ref.

A comparison was made between technologies used in water treatment and waste water treatment in Hungary. It was shown that both types of processes are based on the separation of substances according to size. Several tables are presented, systematically comparing the efficiencies of various technologies which are common to both potable water treatment and waste water treatment. In the treatment of waste water, the transformation of organics into inorganics and their subsequent removal, usually by biological treatment, is frequently necessary. In treatment of drinking water, the goal is generally the removal of undesired substances and sometimes the addition of specific chemicals. Despite the differences in objectives, this paper recommends that professionals in the fields of water treatment and waste water treatment note the similarities of the technology applied.

*Waste water treatment, *Water treatment, *Treatment facilities, *Biological treatment, Separation techniques, Potable water, Organic compounds

*Hungary

J204
PARAMETERS FOR ESTIMATING ANNUAL RUNOFF AND SOIL LOSS FROM AGRICULTURAL LANDS IN RHODESIA,

Elwell, H. A., and Stocking, M. A.

Agricultural Engineering Centre,
Borrowdale, Salisbury, Rhodesia.

Water Resources Research, Vol. 11, No. 4, p 601-605, August, 1975. 2 fig, 4 tab, 12 ref.

The relationships between annual runoff yields and soil losses from arable and grazing lands in developing nations in subtropical climates have not yet been established. An accepted "universal soil loss equation" requires many parameters for predictive estimates. Because data are scarce, runoff and soil loss estimates must be based on rainfall parameters integrating several factors. Using trial field plots in Rhodesia, it was found that energy parameters were the most accurate predictors of the soil loss from bare soils, and could be used to explain 96.4% of the variation in results from a clay loam and 80.0% from a sandy soil. Precipitation quantities falling at threshold intensity levels proved to be practical parameters of annual soil loss and runoff. Other contributing factors for prediction were the percent vegetal cover, the condition of the vegetation at the time at which a storm occurs, and the infiltration rate of the particular type of soil. While climate, soils, vegetation, and slope have an interactive effect, it is difficult to decide the relative importance of each factor in determining soil loss estimates. For newly developing agricultural areas, such as Rhodesia, the use of rainfall parameters and percentage of exposed soil (based on vegetal cover) is the best available approach for designing soil and water conservation works.

*Rainfall-runoff relationships, *Agricultural runoff, *Soil erosion, Soil management, Rainfall intensity, On-site investigations, Precipitation (atmospheric), Climates, Soil conservation, Design criteria

*Soil losses

J205
DESIGNING WATER TREATMENT PLANTS AT THE CIVIL ENGINEERING CONSULTING FIRM MELYEPTERV (VIZTISZTITAS TERVEZES A MELYEPTIESI TERVEZO VALLALATNAK),

Peter, G.

Hidrologiai Kozlony, Vol. 55, No. 6, p 233-235, June, 1975.

The accomplishments of the consulting engineering firm Melyepterv in Hungary as the first native firm to design water treatment plants are described. Until the 1950's all water treatment facilities in Hungary had been constructed by foreign corporations. With development in urbanization and industrialization, new problems of water management have occurred. Experiences with removal of suspended solids, and water softening and desalination for industrial plants, and design of facilities for potable water have been successful. Also, iron and manganese removal and the treatment of surface waters to a potable water quality have been achieved. Research and development has been carried out at Melyepterv in the operation of new facilities. Such technical knowledge has been applied to clarification, filtration, iron and manganese removal, and taste and odor control. A review is presented of the standardization and product development at this firm and the water treatment plants developed by Melyepterv over the past two decades for customers in Lebanon, Nigeria, Cuba, and Czechoslovakia.

*Water treatment, *Design criteria, Treatment facilities, Potable water, Civil engineering, Engineering personnel, Reviews, Surface waters, Foreign research

Hungary, Melyepterv

J206
A STRATEGY FOR WATER POLLUTION CONTROL IN BRITAIN,

Askew, M. W.

Water and Pollution Control, Vol. 113, No. 8, p 16-18, August, 1975. 2 fig, 2 tab, 7 ref.

A synopsis of the Annual Conference of the Institute of Water Pollution Control held at Scarborough, England, is given. This conference provided the first opportunity for a national discussion of the major reorganization of administration of water resources in England and Wales which became effective in April of 1974. The Water Act 1973 transferred the overall responsibilities for water resources to nine regional water authorities in England and a National Water Development Authority in Wales. The first session of the conference discussed corporate management for water authorities. Corporate management was defined as the management organization and structure of an authority necessary for comprehensive planning and implementation of the use of its resources to achieve its aims. A paper entitled "Water Resource Planning" identified the role of the water resources planner as developing long-term strategies which would meet multiple objectives at minimal cost. Future prospects of water authorities were dealt with in two papers on "Operations in Regional Water Authorities, and "Scientific Services in Regional Water Authorities". Distinctions were made between physico-chemical treatment of raw sewage and physico-chemical methods for tertiary treatment. Two physico-chemical and biological sewage treatment pilot plants under construction as part of an advanced waste treatment project for NATO were also discussed.

*Waste water treatment, *Sewage treatment, *Water resources, *Administration, *Conferences, Management, Planning, Biological treatment, Tertiary treatment

Physico-chemical treatment

J207
THE REVOLUTION IN WATER MANAGEMENT,

Rittenhouse, R. C.

Power Engineering, Vol. 79, No. 8, p 28-35, August, 1975. 2 fig, 2 tab.

Water management and its influence on all aspects of power generation is discussed. Because of the Federal Water Pollution Control Act Amendments of 1972, all new plants must conform to EPA guidelines or must convert to a closed-cycle cooling system. The field of environmental management is rapidly growing, and a multidisciplinary staff includes: chemists, biologists, meteorologists, physicists, mathematicians, and socio-economists, as well as civil, mechanical, and chemical engineers. With this approach, the functions of cost-benefit analyses and the solving of specific technical problems may best be implemented. Industry objections to the new EPA guidelines have been that stringent legislation fails to recognize differences in the location, design and requirements for the operation of individual power plants. The largest protesting group was the Utility Water Act Group (UWAG), which opposed most strongly the guidelines for thermal effluents. Costs versus benefits of control measures are discussed, and a possible change in water pollution control policies which might take place between the 1977 and 1983 compliance deadlines is recommended. Specific problems of various facilities, including dry and hybrid cooling towers, cooling ponds and lakes, and spray ponds and canals are detailed. Also considered are new business opportunities in water and waste management, as a result of new applications of reuse.

*Water management (applied), *Power system operation, Water reuse, Legislation, Federal Water Pollution Control Act, Environmental effects, Cooling towers, Thermal power, Thermal pollution, Water pollution control

*Closed-cycle cooling system, Guidelines

J208
A HISTORY OF SEWAGE WORKS' MACHINERY,

Cargill, J. D.

Water Pollution Control, Vol. 74, No. 4, p 430-454, 1975. 9 fig, 127 ref.

A history of the machinery associated with sewage treatment facilities is presented. Since the development of this equipment reflects the development of treatment methods, a review of the developing processes is also presented. The principal methods employed in the nineteenth century were irrigation, filtration and chemical precipitation. Biological processes were developed late in the nineteenth century. By the 1930's, most of the equipment available today had been developed; many improvements have been made during the last forty years. Descriptions are given of machinery that had actually been used in practice from 1840 to mid-1930. Sewage works' machinery can be divided into three broad groups: pumps, screens, detritus removal and scrapers that are used irrespective of the type of treatment; equipment associated with biological processes, such as distributors and aeration equipment; and, the machinery associated with sludge treatment, such as centrifuges, vacuum filters, and filter belt presses.

*Waste water treatment, *Sewage treatment, Treatment plants, Equipment, Pumps, Screens, Aeration, Sludge treatment, Centrifuges, Filters, Dewatering

J209
A CONTINUOUS GARGANTUAN TASK FOR SEVERN TRENT,

Brewin, D., and Tapson, J.

Water, No. 4, p 23-26, July, 1975. 3 ref.

As one of its first tasks the Severn Trent Water Authority commissioned "Water Quality 1973", a document containing in one volume water quality data covering the whole water cycle. The preparation of this report is discussed. The report required data collection from a variety of sources and this variety led to many difficulties in unifying the data presentation. In addition there were also legal difficulties and many unforeseen problems. Prior to April 1, 1974, the management of water services was the responsibility of 26 statutory water undertakings, 210 local authorities, two drainage authorities and two river authorities within the Severn Trent area. Most of the former authorities had water quality data already processed and on file. It was decided to use this data, obtained over a period immediately prior to reorganization, in "Water Quality 1973". Gathering of the data required for the production of "Water Quality 1973" highlighted the inadequacies of much of the data. "Water Quality 1973" is the baseline report of water quality in the Severn Trent Water Authority. It consists largely of tables of figure; the figures are also illustrated by pie diagrams and colored maps.

*Water supply, *Administration, *Water treatment, *Waste water treatment, *Data collection, Publications, Water quality control, Water analysis

Severn Trent Water Authority (UK)

J210
A TOWNSHIP'S NEED OF FILTERED WATER,

Ghosh, B. N.

Tata Iron and Steel Company, Limited,
Jamshedpur, India, Town Engineering Department.

Journal of the Institution of Engineers (India), Vol. 55, Part PH 2, p 40-42, February, 1975. 5 tab, 3 ref.

In order to determine the future water requirements of the township of Jamshedpur, India, the consumption of water was divided into different consuming divisions: domestic; public and municipal; commercial; industrial; and, miscellaneous and wastage. Tables are presented which illustrate the total daily consumption, both past and present, for each of these categories. The figures have been used to project future consumption figures, on the basis of expected development of each of these five categories. The township may require an average supply of 138 million liters/day of filtered water in 1986, with an expected increase over the following ten years to 157 million liters/day. The consumption rate for the population may reach 452 lped by 1986, and 476 lped by about 1996. Domestic consumption equalled about 75% of the total consumption in 1951, 60% of the total in 1971, and will most likely equal 53% of the total in 1996. In the future more filtered water will be used for industrial, commercial, public and municipal activities and less will be used for domestic purposes. The present growth rate of the curve for miscellaneous use and wastage must be restricted to limit the potential wastage of filtered water.

*Water demand, *Water supply, *Water utilization, Water users, Water requirements, Domestic water, Industrial water

825

J211
THE EFFECT OF FINITE CHANNEL WIDTH ON CONCENTRATION POLARISATION REVERSE OSMOSIS UNDER LAMINAR FLOW CONDITIONS,

Carter, J. W., and Hoyland, G.

Birmingham University, England,
Department of Chemical Engineering.

Chemical Engineering Science, Vol. 30, No. 9, p 1190-1191, September, 1975. 4 fig, 1 tab, 9 ref.

In previously published theoretical treatments of reverse osmosis during laminar flow in channels of rectangular cross-section, the effect of the side walls on the local velocity gradient, and therefore on local concentration polarization, has been assumed to be negligible. The fact that this assumption does not hold true for narrow channels was theoretically investigated by considering the velocity distribution in the cross-section of a channel of finite width. Experimental investigations were conducted by making a membrane impermeable adjacent to the side walls. The effect of the side walls on the velocity profile was theoretically demonstrated to be largely confined to a width adjacent to them equal to the channel height. Two sets of laminar flow reverse osmosis experiments were conducted using sodium chloride solutions. Smooth clean semi-permeable cellulose acetate membranes were used in each case. The experimental and predicted concentration polarization at the membrane surface in each of the two sample compartments was calculated. Masking is required for experimental results to conform with predictions based on an infinitely wide channel.

*Membrane processes, *Reverse osmosis, Laboratory tests, Mathematical models, Separation techniques, Semipermeable membranes, Laminar flow, Membranes, Liquid wastes, Desalination processes, Waste water treatment

J212
OTTAWA PLAYS KEY ROLE IN TECHNOLOGY TRANSFER,

Redekopp, A. B.

Environmental Protection Service,
Ottawa, Canada,
Department of the Environment.

Water and Pollution Control, Vol. 113, No. 8, p 6, 35, August, 1975.

The development of training packages, courses and seminars for personnel involved in the water pollution control field by the Training and Technology Transfer Division (Water) and the Environmental Protection Service in Canada is described. In the Maritime Provinces, a program for waste water treatment plant operators has been designed to train those plant operators in the field as well as new student operators. The format is an audio-visual unit (slides and tapes) with a printed workbook. Additionally, three-day operator training programs have been successfully implemented for extended aeration plant (package plant) operators. For the pulp and paper industry as well as the petroleum refinery industry, special three-day seminars have been conducted. These are designed for regulatory staff employed by both federal and provincial governments and discuss the various unit processes involved in the particular industry. Proceedings from the pulp and paper session have already been published and proceedings of the petroleum refinery session are to be published in the next few months. Discussions are related to industrial regulations and guidelines pertaining to current waste water treatment technology. Much emphasis has been placed on these seminars and conferences by the Environmental Protection Service because the individual plant managers in the typical Canadian small industrial operation does not have the time on a weekly basis to study new information. However, most managers do have the opportunity to attend these special seminars to focus on an important area of concern to their specific field of water pollution control.

*Training, *Professional personnel, *Water pollution control, Canada, Conferences, Waste water treatment, Industrial wastes, Municipal wastes, Treatment facilities

J213
A FOURTH DIMENSION--RECREATION AND AMENITY,

Humphries, J.

Clean Air, Vol. 5, No. 18, p 7-12, Summer, 1975.

A discussion is presented on the use of water resources in Great Britain specifically for recreational purposes and the management of such waters for this purpose. While the Government's three priorities in the reorganization of water services have been securing an adequate clean water supply for the needs of people and industry, provision of enough sewerage and sewage disposal facilities, and cleaning up of most of the rivers by the 1980's, a fourth aim has been added to the national water strategy. This is that water should be viewed as an environmental amenity, for both conservation and recreation. The number of people participating in water-based leisure activities has been increasing in England and Wales and it has been proposed as governmental policy that the amenity use of water space should be protected and promoted at both a regional and a national level. Regional Water Authorities have taken over the functions of River Authorities, responsible for land drainage, pollution control, water resources, fisheries, and water recreation; Local Authorities, responsible for public water supply; and Sewage and Sewerage Authorities. The ten regional Water Authorities are defined in terms of areas and populations; their functions in terms of fisheries, recreation, and amenities are also detailed.

*Recreational demand, *Water management (applied), Water resources, Legislation, Sewage treatment, Water utilization, Water users, Water pollution control, Water demand

Regional Water Authorities (Great Britain)

J214
FACILITIES PLANS: CLEARING UP THE CONFUSION,

Kirk, K.

Journal Water Pollution Control Federation, Vol. 47, No. 8, p 2015-2018, August, 1975.

Section 208 of the Federal Water Pollution Control Act, which relates to planning activity at the state level, is discussed. In particular, Section 208(a)(6) states, "The state shall act as the planning agency for all portions of such state which are not designated." While it has been argued that existing basin planning is not adequate to accomplish control of nonpoint source pollution, it was also stressed that no water quality planning should be carried out for areas in which problems do not exist or will not develop over the 20-year planning period. Revised regulations published on July 16, 1975, are more specific as to the scope of state planning in nondesignated areas and define the state water quality management plan as a "management document". Initial plans must be completed and submitted to the EPA regional administrator by July 1, 1978, and adopted by July 1, 1979. Plans must assess nonpoint source problems and needs; contain a statewide antidegradation policy and methodology for its implementation; forecast both municipal and industrial facilities needs for a 20-year period; define urban and industrial storm water system needs; provide operating and implementing agencies; and analyze the various impacts of the plan. No decision has yet been made as to whether to use Section 208 funds or some other source for the state planning programs, and while regulations specify July 1979 as a plan adoption deadline, NRDC is urging November 1977 as the key date.

*Legislation, *Federal jurisdiction, *State jurisdiction, *Planning, Federal Water Pollution Control Act, Water pollution sources, Water pollution control, Water quality control, Administration, Regulation, Municipal water, Storm water, Water resources development

Nonpoint pollution sources

827

J215
EPA MONEY PROPOSALS CAUSE CONCERN,

Lubetkin, S. A.

Water and Wastes Engineering, Vol. 12, No. 8, p 43-44, August, 1975.

Five administration proposals to amend the Federal Water Pollution Control Act Amendments of 1972, which were suggested in May 1975, are evaluated. Topics were: reduction of the federal share of project costs; limitation of federal funding of reserve capacity to serve projected growth; restriction of the types of projects eligible for grant assistance; extension of the 1977 date for publically owned treatment works to meet water quality standards; and delegation of a greater portion of the management construction grants program to the states. It was argued that even if the federal share of project costs is lowered from 75% to 55%, these figures are for construction costs only, and the operation and maintenance costs will continue to be paid by the municipalities. Secondly, some flexibility must be maintained if funding of prospective growth is limited. If the types of projects eligible for grant assistance are restricted, it is suspected that this will not encourage state or local self-sufficiency. However, high priority items on both the federal and local levels should be financed first. It was strongly suggested that construction grant management programs should be delegated to a state if and only if that state has demonstrated its ability to handle it. It was also recommended that, in terms of the 1977 deadline for water quality standards, the Administrator must grant compliance schedule extensions on an ad hoc basis, upon the availability of Federal funds and upon time required to build the necessary facilities. In summary, treatment and disposal facilities should be reviewed on an individual basis, allowing cost-benefit analyses, and the municipalities should decide what is equitable.

*Legislation, *Federal Water Pollution Control Act, Costs, Federal jurisdiction, State jurisdiction, Construction costs, Water quality standards, Treatment facilities, Waste water treatment

Federal funding, Construction grants

J216
WATER QUALITY MANAGEMENT PLANNING FOR THE ROARING FORK RIVER BASIN IN WESTERN COLORADO,

Hopkins, J. K.

Dissertation Abstracts International B., Vol. 36, p 633-634, 1975.

The Water Quality Management Plan for the Roaring Fork River Basin in Western Colorado has been developed. This plan provides a baseline survey of existing water quality in the area, and has been adopted by the Colorado Water Quality Control Commission to become an element of the Colorado River Basin Plan. The investigation includes the development of a computer model of the basin for the assessment of future water quality, and the analysis of needs and capital expenditures required to maintain high water quality. The Plan also recommends waste load allocations for segments of the Basin. In addition to describing the Water Quality Management Plan, the dissertation presented here describes control and treatment of urban runoff in Aspen, Colorado, and analyzes the significance of the contribution of urban runoff to stream degradation.

*Water management (applied), Water resources development, Colorado, Colorado River Basin, River basins, Water quality control, Urban runoff, Model studies, Planning, Computers, Analytical techniques, Capital costs

J217
CLEAN WATER WILL COST $159 BILLION,

Engineering News Record, Vol. 195, No. 12, p 40, September 18, 1975.

Results of a study by the National Commission on Water Quality on the costs of providing municipal sewage treatment at the government's standards for 1983 "best available technology" are reported. The total spending necessary is about 159 billion dollars. Of this, $79.6 billion will be used for correction of combined sewer overflows, 80% of that for construction of new storage facilities. Secondary treatment to meet the 1977 "best practicable technology" standards will cost $10.8 billion; advanced waste water treatmentment, $24.8 billion; rehabilitation of existing sewer systems, $9.5 billion; infiltration control, $6.9 billion; new collectors, $13 billion; and new interceptors, $13.5 billion. Expenditures are also detailed for publically owned treatment works for construction materials and collection systems. The construction time is estimated, and the majority of this will be used for improving the combined sewer overflows. With the new investment, a 60% decline in BOD and suspended solids removal is projected, as well as an increase in sludge production to a level of 14.4 million tons of sludge on a dry solids basis, compared with 4.7 million tons in 1972. Nutrient output should remain constant, because the volume of waste water will grow considerably. The decision to meet the 1977 and 1983 goals is dependent upon the condition of municipal finances and actions.

*Waste water treatment, *Capital costs, *Operating costs, *Sewers, *Sewage treatment, *Overflow, Infiltration, Construction materials, Sludge, Biochemical oxygen demand, Water pollution control, Analytical techniques

J218
EPA COMPLETES NEW PLANT AND SEWER INDEX DATA SERIES,

Engineering News Record, Vol. 195, No. 12, p 114, September 18, 1975. 3 tab.

The latest Environmental Protection Agency's urban sewer system cost indexes were published and complete the set of cost data for water pollution control construction. Data are presented for 25 cities in each of three categories: 5 mgd municipal waste water treatment facilities; 50 mgd municipal waste water treatment facilities; and complete urban sewer systems. All three indexes' United States averages rose slightly in the third quarter of 1975. The new complete urban sewer system indexes were based on factors including: under labor, common labor, cement finisher, carpenter, and medium equipment operator. Labor rates included fringe benefits. Materials were concrete of the 3000 psi ready-mix type, pipe of reinforced concrete, 24 inches, paving asphalt in tank cars, and lowest grade lumber (2 x 10 S4S). Needs for both old and new indexes were measured by the EPA from the results of a questionnaire given to over 100 public and private recipients of index data. Of 98 responses, 42 expressed a need for the continuation of the old indexes. The latest United States averages for the old indexes, corrected back to June, 1974, are also presented.

*Analytical techniques, *Sewers, *Costs, *Construction, Labor, Data collections, Water pollution control, Concrete, Municipal wastes

Environmental Protection Agency, Sewer Indexes, Cost indexes

J219
ASBESTOS AND CHLORINATED ORGANICS TOP AWWA DISCUSSIONS,

Storck, W. J.

Water and Wastes Engineering, Vol. 12, No. 8, p 26-28, August, 1975.

Discussion of contaminants in waste water and drinking water was presented at the annual conference of the American Water Works Association. The focus was asbestos in potable water supplies and chlorinated organics in discharged effluents. A water treatment plant has been designed to remove asbestos fibers and lower turbidity in Duluth, Minnesota. The 30 mgd system consists of coagulation, flocculation, gravity filtration, wash water recovery, and sludge storage. The question of chlorinated organics as carcinogenic agents was debated, and the need for laboratory research (animal experiments) on the effects of both asbestos and chlorine was stressed. Other conference papers focused on reuse of waste water. The primary example was the Denver, Colorado, program. The proposed treatment method for Denver's 1.0 mgd demonstration plant consists of lime and other chemical coagulants, recarbonation, filtration, nitrogen removal by the clino system and then regeneration using the ARRP stripping process, two stage carbon treatment with chlorine between the stages, a demineralization process, ozonization, and residual disinfection with chlorine. The importance of public opinion for this and other proposed projects was discussed, and it was felt that the public is not generally opposed to reuse.

*Asbestos, Potable water, Waste water treatment, Water treatment, Water supply, Water reuse, Public health

*Chlorinated organics, Contaminants, Denver (Colo.)

J220
SELECTION OF ECONOMICAL PIPE SIZES FOR WATER DISTRIBUTION NETWORKS,

Simmons, D. G.

Applied Cybernetics, Merritt Island, Florida.

Public Works, Vol. 106, No. 9, p 84-85, September, 1975. 1 fig, 1 tab, 4 ref.

A thorough analysis of hydraulic data for a water distribution system does not ensure that the most economical pipe size will be chosen. Pipe size selection is more dependent on economic factors than it is on hydrodynamic considerations. The most economical pipe sizes are determined by pipe diameter, pipe cost, and pumping cost. For any given pipe cost schedule, interest rate, power rate, flow rate and amortization rate, there is a most economical pipe size. Determination of the optimum set of economical pipe sizes for a distribution network is an iterative process involving the combination of the economical diameter calculation with the flow distribution analysis. Manual application of this analytical procedure is very time-consuming, however, the use of large high-speed time sharing computers facilitates the analysis. The "Econ 2" program has been designed to add economical pipe size calculations to an existing software program for the analysis of flow and pressure distribution, "Water X". The application of "Econ 2" to a small distribution system is illustrated by tables showing the system costs based upon the originally estimated pipe sizes and the cost analysis after calculation of the economical pipe sizes using "Econ 2". Selection of economical pipe sizes can represent a substantial cost difference. This procedure should be employed when constructing a new water distribution system or expanding an existing system.

*Water distribution (applied), *Pipes, *Distribution systems, Piping systems (mechanical), Costs, Economics, Evaluation, Computer programs, Analytical techniques

Pipe size selection, "Econ 2"

J121
SAFE DRINKING WATER ACT ACT I SCENE I OF HERE WE GO AGAIN,

Beckroth, C. W.

Water and Wastes Engineering, Vol. 12, No. 8, p 14-18, 20, 22, 24, August, 1975.

A critical review of the new safe drinking water legislation, PL 93-523, is presented. Four areas of controversy at the American Water Works Association annual conference were the chlorine/carcinogen controversy, effluent guidelines for water treatment plant waste disposal, waste water reuse for potable water and the impact of this Act. Speaking for the EPA, John Quarles argued that the methods of achieving goals for better water quality would be more flexible and realistic than those of PL 92-500. Negative reactions to the Act were expressed by some state representatives, who felt that the Federal government will have too rigid control over areas that have been under state jurisdiction. Specific criticisms of the Safe Drinking Water Act included: the chlorine residuals portion of the Act should be amended to allow for a level of 1.0 mg/liter in the distribution system; more emphasis should be placed on corrective action, rather than reporting violations and taking samples; turbidity should not be a primary standard because that action disregards regional differences; not enough stress has been placed on inspection of systems and correction of marginal conditions; and various funding aspects are poor and the individual customers are expected to pay for increased services "whether or not they want these services." Overall, there is a basic difference in philosophy between the EPA and the states as to whether a water quality control program should be directed towards protection of health or towards being cost-effective.

*Legislation, Effluents, Water treatment, Waste water treatment, Regulation, Federal jurisdiction, State jurisdiction, Water quality control, Public health

Safe Drinking Water Act, Cost-effectiveness, Environmental Protection Agency

J122
ORGANICS, WATER, AND HEALTH: A REUSE PROBLEM,

Reinhardt, A. W., Spath, D. P., and Jopling, W. F.

California State Department of Health,
Los Angeles, California,
Water Sanitation Section.

American Water Works Association Journal, Vol. 67, No. 9, p 477-480, September, 1975.

The use of reclaimed waste water for augmenting domestic water sources is discussed as a major cause for health concern due to effects of stable organic material in the waste water. While reclaimed waste water has been used for crop irrigation of crops with little public contact, the usage has been expanded to include public areas. The last use of reclaimed water has been direct discharge for supply augmentation into a domestic water system or storage facility. The California State Department of Health strongly recommends against the continued use of recharge operations which increase the stable organic loadings of groundwater used for domestic supply. The health effects of such organic materials remain unknown and research is as yet in a preliminary stage. Plans for new spreading and injecting facilities, including the Anaheim Forebay Reclamation Project and the Los Angeles Water Recycling Project, are under review.

*Water reuse, *Organic matter, *Waste disposal, Waste water treatment, Water supply, California, Public health, Recycling, Recharge, Groundwater, Water resources development

Reclaimed waste water

J223
EQUILIBRIUM ADSORPTION OF INORGANIC PHOSPHATE BY LAKE SEDIMENTS,

Ku, W. C.

Dissertation Abstracts International B, Vol. 36, No. 2, p 874, 1975.

Eutrophication has become a problem of national concern. An understanding of the behavior of phosphorus in different waters is essential to insure control of eutrophication. A study was undertaken on Lake Warner and Lake Wyola, both in Massachusetts, on the adsorption of inorganic phosphates in surface sediments. The pH, temperature, and redox potential were studied. An isotopic exchange method, using P32, was used to determine the phosphorus attached to the surface of the sediment, and to determine the adsorption maxima. For the two lakes studied, the Langmuir adsorption equation accurately described the phosphate adsorption data. Adsorption capacities for the sediments increased as pH and temperature decreased but as redox potential increased. Iron and aluminum were important in the fixation of phosphate in lake sediments, the relative importance depending on the type of sediment and the environmental conditions prevailing in the sediment. It was found that changes in redox potential caused changes in the amount of iron released from the sediment but had no effect on the aluminum. Redox potential can be used as an important parameter for sediment phosphate adsorption studies The data derived from these studies can be used for mathematical models for the prediction of the phosphate exchange processes between lake sediment and the overlying waters.

*Equilibrium, *Adsorption, *Phosphorus compounds, *Lake sediments, Temperature, Oxidation-reduction potential, Environment, Mathematical models, Isotope studies, Eutrophication, Water pollution, Iron, Aluminum, Hydrogen ion concentration

*Surface sediments, Lake Warner (Mass), Lake Wyola (Mass), Langmuir adsorption equation, Isotopic exchange

J224
LOCAL LAND USE CONTROL OVER CRITICAL AREAS,

Thurow, C.

American Society of Planning Officials, Chicago, Illinois.

Civil Engineering-ASCE, Vol. 45, No. 9, p 73-76, September, 1975. 4 fig.

States can no longer handle all of the environmental problems and decisions that may develop. Along the southeastern coast of Texas recently, the sand aquifier has been heavily pumped, causing groundwater to be extracted faster than it could be replaced. Expensive problems have developed. The willingness of local communities to become involved in regulating local environmental problems is discussed. The planner in a community is the best qualified on a local level to judge what degree and type of development a particular area will tolerate. The other approach is by making local ordinances prohibiting certain types of development or limiting use of such areas as wetlands or streams. Most ordinances remain simple, allowing light use or use with a special permit. but some have moved beyond that stage. Very few have been challenged in court, the most important reason being that they are more flexible than they appear. Their main purpose is to insure the involvement of local government in the development process. They force a case by case administrative process, requiring more time and more expertise on the local level. Disadvantages that may arise are the probabilities of human error in difficult decisions and pressure from special interest groups. Environmental performance standards can overcome some of the difficulty, by promoting compatible development.

*Land use, *Local governments, Environmental control, State governments, Legislation, Permit, Developed waters, Standards, Groundwater, Sand aquifiers, Wetlands, Streams

Land Development, Special interest groups

J225
SOME ENVIRONMENTAL PROBLEMS AND THEIR SATELLITE MONITORING,

Otterman, J.

Tel Aviv University,
Israel,
Department of Environmental Sciences.

Journal of the British Interplanetary Society, Vol. 28, No. 9/10, September/October, 1975. 5 fig, 38 ref.

Results from the first Earth Resources Technology Satellite in monitoring land and water surface changes are presented. Previous studies utilizing this type of satellite and its imagery have been performed in the fields of agriculture, forestry, hydrology, oceanography, limnology, and pollution studies. The possibilities of modifying the sensors of the ERTS (LANDSAT) series satellites for appropriate environmental monitoring are discussed. Some of the dangers linked to land use pressures and surface pollution, such as climatic modification and severe regional environmental impact, are surveyed. Two areas for which monitoring is necessary are: the determination of land use changes due to overgrazing and how such changes affect albedo and land surface-atmosphere interactions; and the determination of land and water surface pollution, particularly the detection of oil slicks. Satellite monitoring is proposed both for assessing the land use and pollution situations and for introducing and following remedial procedures.

*Satellites (artificial), *Monitoring, Surface waters, Water pollution sources, Oil spills, Land use, Water pollution control, Waste treatment

Albedo

J226
WATER QUALITY STUDIES AND LAND-USE MAPPING USING ERTS-1 DATA,

Hellden, U., and Olsson, H-A.

Lund University,
Sweden,
Department of Geography.

Journal of the British Interplanetary Society, Vol. 28, No. 9/10, September/October, 1975. 9 fig, 15 ref.

The use of ERTS-1 data for water quality studies and land-use mapping is discussed. In this application, sewage conditions of Copenhagen in the Oresund and 161 lakes in South and Middle Sweden were investigated. The effects of waste disposal from sewers on lake eutrophication may be observed by satellite MSS images. Industrial pollution was also observed, including the discovery of a belt of oil pollution in the southern part of the Baltic. Circulation of polluted water due to municipal and industrial wastes was followed. A variation in reflectivity of a great number of the lakes was found, and significant regional differences were compared. Correlations between the satellite spectrophotometry measurements and in situ turbidity and transparency data were quite good. The MSS images of chlorophyllic (containing algae and plankton) water reflected most intensively within the band 0.4 to 0.6 micrometers and industrial water pollution reached highest reflection in the band 0.6 to 0.7 micrometers. It was thus shown that the channels most suitable for water quality detection are ERTS-1 MSS4 and MSS5. From the imagery data gathered, a detailed differentiation of land use for the coastal area of Sweden was prepared.

*Satellites (artificial), *Monitoring, *Land use, Pollutant identification, Oil spills, Lakes, Industrial wastes, Eutrophication, Sewerage

LANDSAT, Sweden

J227
MOODY DIAGRAM FOR DIRECT PIPE DIAMETER CALCULATION,

Lai, R. Y. S., and Lee, K. K.

Wisconsin University,
Milwaukee,
Department of Energetics.

Journal of the Hydraulics Division-ASCE, Vol. 101, No. HY10, p 1377-1380, October, 1975. 1 fig, 9 ref.

Determining the best pipe diameter size for rough commercial pipes is a necessary step in design for fluid flow applications. The modified Moody diagram and its associated pipe diameter formula are illustrated as a direct time-saving method for finding the desired pipe size. A continuity equation and the Darcy-Weisbach equation are derived, and a Moody diagram with an auxiliary scale Reynolds number versus the friction factor for various relative roughness has been plotted. An alternative Moody diagram for finding the diameter directly is illustrated, where a suitable scale can be found without explicitly depending upon pipe diameter in the roughness of the pipe/pipe diameter scale.

*Equations, *Pipes, *Mathematical models, Flow, Design, Moody resistance diagrams, Pipe flow, Darcy-Weisbach equation

J228
GOVERNMENT DOLLARS TO FUEL 18% GROWTH IN 1976 SEWERAGE MARKET,

Engineering News Record, Vol. 195, No. 13, p 10-11, October 2, 1975. 2 tab.

A survey of 82 major sanitary districts indicated that they plan to spend more than twice the sewerage construction dollars in fiscal 1976 than in the preceding year. Over half the planned spending is for new or expanded treatment plants, comprising about one-third of all United States sewerage construction. Earlier this year, $9 billion in impounded pollution control construction funds were released by the federal government, constituting the legislation of a demand for increased sewerage construction. Of the 82 districts reporting, 34 will have $1.9 billion worth of advanced waste water treatment plants under construction by 1979. The greatest growth in fiscal 1976 from 1975 is shown by the Middle West and Middle Atlantic districts. Southern and far western districts plan growth 60% above fiscal 1975; and 11 districts between the Mississippi River and the Rockies have plans to decrease 1976 spending by 24%. A weakness in the project-distribution is that four big cities' fiscal 1976 and 1977 predictions account for 50% of the total reporting districts. These cities--New York City, Chicago, Detroit, and Los Angeles--have $2.8 billion allotted for sewerage construction in 1976 and 1977. With trends towards higher interest rates required to market bonds, problems with municipal funding may injure the market of construction progress in the next year.

*Construction, *Sewerage, *Waste water treatment, *Treatment facilities, Tertiary treatment, Legislation

Federal spending, Sewerage construction

J229
ALARM SYSTEMS PROVIDE LOW COST ENVIRONMENTAL PROTECTION,

Walter, C. E.

Reavin Company,
Consulting Engineers,
Baltimore, Maryland.

Public Works, Vol. 106, No. 10, p 88-89, 112, October, 1975.

The use of automated alarm systems for waste water treatment plants and pumping stations is discussed. To be effective, these malfunction alarms must attract human attention and must generate a response. It is recommended that the alarms be designed to transmit a signal to a remote location which is manned 24 hours a day so that the alarm will receive immediate attention. The types of failures or malfunction that can be detected include power failure, high water, loss of air in an activated sludge plant, excessive turbidity, excessive sludge accumulation, pump or motor failure, primary tank malfunction, high or low chlorine residual, or chlorine gas leaks. The Mount Airy, Maryland, treatment plant is cited as an example where the alarm system has been custom designed and fabricated. A less sophisticated equipment may be used to monitor a small treatment plant, adapting standard burglar alarm components. Receivers of an alarm signal can be placed in a police or fire station so that when a failure alarm is signaled, the appropriate plant operator will be contacted. Another type of burglar alarm system is an automatic telephone dialer, which is activated by the alarm system controller to automatically call as many as four different telephone numbers, sending a recorded message to each. Costs of basic detectors, control unit, and telephone dialer were estimated to be $500 per plant; installation costs should not exceed $500.

*Automation, *Treatment facilities, *Waste water treatment, Pollutant identification, Equipment, Monitoring, Installation, Control systems, Costs

*Alarm systems, System malfunction, Automatic telephone dialer

J230
PENNSYLVANIA USES CREATIVE APPROACH TO WATER QUALITY MANAGEMENT PLANNING,

Steigman, H.

Field Operations, Environmental Protection and Regulation,
Pennsylvania Department of Environmental Resources.

Journal of Environmental Health, Vol. 38, No. 1, p 45-48, July-August, 1975.

Pennsylvania is designing a Comprehensive Water Quality Management Planning Program (COWAMP) which will focus on technological, environmental, economic, social and management aspects of water quality management. Results should meet the requirements of the Pennsylvania Clean Streams Law and of PL 92-500. Each of the nine study areas that the state has been divided into will have a Coordinator, Consultant, Policy Advisory Committee, a Technical/Study Advisory Committee, a Department of Environmental Resources regional offices and Areawide Planning Organization. COWAMP will include significant local participation and is of an interdisciplinary nature. A notable feature of COWAMP is its consideration of alternative environmental futures; this will consist of an environmental inventory of assets and values present in any given area, followed by the establishment of objectives and policies concerning the said values and assets. Present waste water management services in Pennsylvania are constraining and create financial inequities between neighboring areas. COWAMP's financial designs will be fully incorporated into the physical system alternatives. In this manner, it will be possible to create a financial maintainable system.

*Water quality, *Administration, Water quality control, Water pollution control

Comprehensive Water Quality Management Planning Program

J231
STAGE 1 DEVELOPMENT OF THE SHOALHAVEN SCHEME-I,

Snowy Mountains Engineering Corporation, Australia.

Water Power and Dam Construction, Vol. 27, No. 8, p 275-282, August, 1975. 4 tab, 9 fig.

The Shoalhaven scheme, divided into three stages, is being developed in order to increase safe sewerage and supply system draft. It is headed by the Sydney Metropolitan Water Sewerage and Drainage Board (the Board) and by the Electricity Commission of New South Wales (the Commission). Facilities for phase 1 of stage 1 are discussed in detail. The Shoalhaven was chosen because it was the only catchment potentially able to meet the Board's requirements up to the year 2010. Stage development was advised in order to cumulatively increase the safe draft of the total system of 340Ml/day by 1975, 1250Ml/day by 1982, and 2140Ml/day by 2000. Stage 1 is functionally divided into two projects: the Kangaroo-Fitzroy project which includes all works from the Tallowa dam north to the Fitzroy Falls reservoir and which is involved in pumping capacities; and, the Burrawang-Wingecarribee project which includes all works north of Fitzroy Falls reservoir that transfer pumped Shoalhaven water into the Nepean and Wollondilly catchments and which will include the building of a dam. Operational and dimensional data for the various dams are shown in the tables. The main features of the scheme comprise the Tallowa dam, the Bendeela power station, the Bendeela pipeline, the Bendeela pondage, the Kangaroo Valley facilities, and the Fitzroy canal and Fitzroy Falls dam.

*Sewerage, *Water supply, *Electric power, Dams, Construction

Catchments, Draft

J232
R&D PRIORITIES ON THE NATIONAL AGENDA FOR WATER POLLUTION CONTROL,

Engelbrecht, R. S.

Professional Engineer, Vol. 45, No. 10, p 21-23, October, 1975. 2 fig, 3 tab.

The 1985 goals of the Federal Water Pollution Control Act Amendments of 1972 will not be met if the provision of funds for research and qualified research personnel is maintained at its present level. EPA financing of municipal technology R&D has been greatly reduced since 1967. No adjustments have been made for inflation. The number of students enrolled in water pollution control academic programs has also decreased. This is partially due to the reduction of EPA funding for graduate or professional training grants. The present training grant program will end in July 1976. Even though present knowledge and technology have been of undeniable use, additional knowledge and technology are needed if the desire for further growth and development and the necessary improvement of water resources are to be conciliated. Four major aspects of research are briefly reviewed: analytical techniques; waste water treatment; residue management; and environmental effects.

*Water pollution control, *Legislation, *Financing, *Research and development, Analytical techniques, Waste water treatment, Environmental effects, Personnel

Federal Water Pollution Control Act Amendments of 1972

J233
ENVIRONMENTAL CHEMISTRY IN THE NETHERLANDS,

Karasek, F. W., and Hutzinger, O.

Waterloo University, Waterloo, Ontario, Canada,
Department of Chemistry.

Research/Development, p 40-46, September, 1975. 4 fig.

Although, in most countries, environmental control programs are focused on monitoring and testing pollutants, the Netherlands has expanded its research to environmental chemistry. Highly industrialized, small and densely populated, the Netherlands has managed to limit the number of industrialized areas by means of good land management and a growing fight against present and potential pollution problems. Research has been mainly conducted in government laboratories and secondarily in some universities. Now, however, academics are playing an increasingly important role. Many universities have programs in the environmental sciences although only the University of Amsterdam has a graduate program leading to a degree in environmental chemistry. Some departments participate in government sponsored interdisciplinary studies which include environmental chemistry. Course work for the latter is broad while student research projects are highly specific. Research in environmental chemistry involves finding and identifying a great number of complex and changing organic compounds many of which are found in complex environmental milieux and in quantities of a nanogram and picogram dimension. Improved analytic procedures are being evolved for such compounds.

*Water pollution control, *Foreign research, *Education, Research and development, Analytical techniques, Pollutant identification

The Netherlands, Environmental chemistry

J234
MAINTENANCE OF WATER QUALITY,

Pullin, J.

Surveyor, Vol. 146, No. 4344, p 7-8, September, 1975.

The main topics of a symposium held by the Institution of Water Engineers and Scientists are reviewed. Protective measures for three water sources were first considered. Reservoirs are now more accessible to the public, and new means of protecting them must be found to avoid a higher risk of pollution. The bulk of pollutants must be expelled from river sources, and the remaining portion treated. The establishment of the river intake, monitoring, and storing, as well as an efficient liaison system are essential for maximum protection. Groundwater sources should be protected to avoid potential areas of pollution, and buildings, agriculture and industry should also be carefully planned. Discussion of the control of effluents dealt with the legislative aspects of pollution control and with the problems involved in presenting water standards. The need was expressed to reevaluate the bases for the application of effluent standards and to produce more effective screening of new chemicals involved in industrial processes. Also discussed were the criteria defining raw water and the means of monitoring it. Three types of emergencies were listed and emergency handling procedures based on a coordinated management structure with efficient communications were proposed.

*Water quality control, *Standards, *Water pollution control, Reservoirs, Water supply, Monitoring, Waste water treatment, Legislation, Chemical wastes

837

J235
WATER RESOURCES PLANNING IN URBAN AREAS,

Fulton, R. L.

Office of Chief of Engineers, U.S. Army,
Washington, D. C.,
Urban Studies Branch.

Journal of the Hydraulics Division-ASCE, Vol. 101, No. HY9, p 1249-1255, September, 1975. 1 ref.

Initiated in 1972 by the U.S. Army Corps of Engineers, an "Urban Studies Program" had as its objectives the establishment of pilot waste water management programs in five major urban areas. The program was developed on the principles that: the responsibility for and leadership of urban area comprehensive planning is in the hands of state and local governments; and conflict and duplication among Federal agencies participating in such urban planning is to be avoided. The Urban Studies Program is limited to water resources functions and includes: urban flood control; flood plain management and information studies; waste water management; water supply; regional harbor and waterway needs; bank and channel stabilization; lake, ocean, and estuarine protection; and recreation at water resource projects. Each study lasts three to four years after funds are available, and will produce a series of three to seven alternative urban water resources plans. The plans are to consist of capital improvements, a management program, and a revision program. At present, 33 studies are underway, with the cost of each averaging $1.5 million. Of two initial studies, one study on the Colorado River and Tributaries, Texas, has been completed. Its scope was limited to waste water management. Alternatives in this field include physico-chemical and advanced biological technologies as well as the encouragement of land treatment methods that are environmentally and economically sound.

*Waste water treatment, *Pilot plants, *Water resources development, Water management (applied), Flood control, Costs, Planning

*Urban areas, *Waste water management

J236
DESIGN OF IRRIGATION RUNOFF RECOVERY SYSTEMS,

Stringham, G. E., and Hamad, S. N.

Utah State University,
Logan,
Department of Agricultural and Irrigation Engineering.

Journal of the Irrigation and Drainage Division-ASCE, Vol. 101, No. IR3, p 209-219, September, 1975. 2 fig, 5 ref.

The design of an Irrigation Runoff Recovery System (IRRS) is described and evaluated. Using this sytem, the need for a cut-back type of irrigation is eliminated by the use of a constant supply stream discharge, a constant discharge from the recirculating pump, a constant furrow discharge, and a constant number of furrows in each set. In order to adjust the set size and furrow discharge rates to accomodate the intermittent flows from recirculating pumps, a design technique has been developed that permits a constant inflow to all furrows of the irrigation, with no net runoff from the field. This is achieved by irrigating the entire set of irrigation fields from the inflow water and collecting the runoff in a storage reservoir. All of the remaining sets, except the last set, are irrigated by both the supply stream and runoff water, recirculated by pump. The last set is irrigated only from the stored runoff water. Thus the layout calls for n + 1 irrigation sets, and at the end, no water should remain in the storage reservoir. This technique allows planners to determine the number of furrows to be irrigated from the supply and pumped streams, the number of sets and furrows in each, the volume of storage required in the storage reservoir, and the recirculating pump flow rate.

*Irrigation, *Mathematical models, Design criteria, Water reuse, Runoff irrigation water, Agricultural runoff, Storage requirements

838

Irrigation runoff, Irrigation Runoff Recovery System (IRRS)

J237
MUNICIPAL WASTEWATER PLANT PROBLEMS WITH CYANIDE EFFLUENT REGULATIONS,

Lordi, D. T., Lue-Hing, C., and Knight, E.

The Metropolitan Sanitary District of Greater Chicago, Illinois, Industrial Waste Division.

In: Proceedings of the 29th Industrial Waste Conference, May 7, 8, and 9, 1974, Lafayette, Indiana, Purdue University, p 338-347. 5 fig, 5 tab, 6 ref.

The Illinois Pollution Control Board (IPCB) cyanide standard of 0.025 mg/liter for discharge to waterways and to municipal sewer systems was evaluated. Studies were performed on the determination of cyanide levels present in treatment plant effluents and the raw sewages to each of the three major Chicago-area treatment plants. Other sources of cyanide not attributable to industrial cyanide wastes were also measured. The possible identification of effluent cyanide as simple and/or complex was then made. It was found that effluents from some of the smaller treatment plants having no known significant industrial waste load showed daily values exceeding the 0.025 mg/liter limit (including analytical variations). Between 92 and 100% of the time, these plant effluent cyanide levels were below 0.050 mg/liter, and averaged between 0.010 mg/liter and 0.024 mg/liter. A program has been initiated to determine whether the form of cyanide occurring in raw sewages and final effluents is simple or complex. It appears so far that 67% of the raw sewage entering the Calumet (a large industrialized plant) facility is of the complex form, and that cyanide generally predominates in the complex form. Because there are non-industrial sources of cyanide in domestic waste waters that would not be controllable through industrial waste enforcement, it was concluded that effluents from municipal treatment plants would have low levels of total cyanide in excess of the present IPCB standard at least some of the time. Further investigation is recommended to determine the proportions of simple and complex cyanide compounds found in effluents and their relative toxicities, in order to evaluate the numerical limit for cyanide level.

*Toxicity, *Effluents, *Waste discharge, *Industrial wastes, *Municipal wastes, *Pollutant identification, *Sewage treatment, *Waste water treatment, Analytical techniques, Legislation, State jurisdiction

J238
DISTRIBUTION AND BIOMAGNIFICATION OF HEXACHLOROPHENE IN URBAN DRAINAGE AREAS,

Sims, J. L., and Pfaender, F. K.

North Carolina University, Chapel Hill, School of Public Health, Department of Environmental Sciences and Engineering.

Bulletin of Environmental Contamination and Toxicology, Vol. 14, No. 2, p 214-220, August, 1975. 2 fig, 1 tab, 10 ref.

A study was performed to determine the presence of hexachlorophene (HCP) in the waterways of the Upper Haw River Basin near Greensboro, North Carolina. The distribution data indicate that the two area waste water treatment plants are the major sources of HCP. Hospitals are probably the most significant sources of HCP to the treatment facilities. The organisms collected during the study all showed HCP concentrations significantly higher than those found in the water or sediment. Considerable biomagnification seems to be occurring in the water scavengers, crayfish and water boatmen. The HCP levels found in the water and sediment do not represent a direct danger to human health and are not toxic to environmentally significant microorganisms. However, the evidence for the biomagnification of HCP from the low concentrations in water to potentially toxic levels warrants a more detailed study of the extent and effects of HCP contamination of the environment.

*Pollutant identification, *Water pollution sources, *Chemical wastes, Treatment facilities, Environmental effects, Public health

Hexachlorophene, Biomagnification, Hospital wastes

J239
CAN WE AFFORD ZERO POLLUTION RISK?,

Ledbetter, J. O.

Texas University, Austin,
Department of Civil Engineering.

Water and Sewage Works, Vol. 122, No. 9, p 104-105, September, 1975. 5 ref.

The goal of zero pollution has been developed by an advertising campaign by Federal environmental agencies and the zero defects concept from the space program. The pollution regulatory agencies use the health effects of pollutants as the reason for pollution control and use the advertising campaign to build their empires through increased budget appropriations from a frightened congress. Toxicologists believe that small doses of toxic materials will stimulate while epidemiologists maintain that even a small exposure to a large population for a long period of time can cause disease. The epidemiologist arrives at this conclusion through the use and misuse of statistics. Life scientists are overawed by statistics and assume spurious and specious correlations and then use these correlations to prove cause-effect relationships. Spurious and specious correlations will continue to be promoted as long as publicity or appropriations of money for studying the pollutant are to be gained. However, there is a chance that many actions taken to prevent some real or imagined ill will cause more damage than the status quo. Pollution control should be free of ambivalence, and a single air quality standard for the entire country should not be adopted. The environment can safely assimilate at least small amounts of pollutants. The proper level of pollution control will ensure a balance of sociological desireability, technological capability, economical feasibility, and environmental assimiliability.

*Pollution abatement, *Statistics, Toxicity, Public health, Epidemiology, Water pollution, Air pollution, Standards, Pollutants, Waste assimilative capacity

Zero discharge

J240
FACING UP TO SLUDGE DISPOSAL IN NEW JERSEY,

Remley, S.

Compost Science, Vol. 16, No. 4, p 26-27, July-August, 1975.

An on-going test has been conducted for the past three years at six sites in New Jersey to determine if treated sludge can be used as a soil conditioner. This study is one of the most extensive of this type in the world. Some off-site contamination was observed from the site which was receiving sludge at an application rate of 40 ton/acre/yr. The use of sludge as a soil conditioner at a 20 ton/acre/yr application rate is showing promise. Successful implementation of this type of disposal method could reduce by one-half the cost of disposing of sludge in landfills. Manure from animal feedlots as an economical source of methane gas is being investigated in Texas and Colorado. Bio Gas of Colorado, Incorporated, has built a plant to make 4 million cu ft of gas daily from 450,000 tons of cow manure yearly. Era is building a methane producing plant adjacent to a cattle feedlot in Deaf Smith County, Texas. A tidal marsh that is alternately flooded by water and then exposed to the sun and air and that has the ability to withstand and absorb wave action has been created near Hambleton Island, Maryland. An intertidal sand flat was first built and then planted with 60,000 seedlings. The experiment is part of a five year plan to explore new, ecologically acceptable uses for part of the 380 million cubic yards of sediment dredged up yearly by the corps.

*Waste disposal, *Sludge disposal, Soil science, Methane, Feed lots, Marshes, Soil contamination, Dredging

Soil conditioner, Manure

J241
FATE OF WASTEWATER PHOSPHORUS IN SOIL,

Enfield, C. G., and Bledsoe, B. E.

Environmental Protection Agency, Ada, Oklahoma,
Water Quality Control Branch.

Journal of the Irrigation and Drainage Division-ASCE, Vol. 101, No. IR3, p 145-155, September, 1975. 5 fig, 1 tab, 18 ref.

The effects of applied phosphorus to a land application waste water treatment system were considered. Because phosphorus concentrations entering surface water must be low enough to avoid an accelerated eutrophication rate, both the amounts of residual phosphorus in the soil solution and the soil's ability to sorb applied phosphorus must be known. It proved possible to quantitatively project the minimum residual concentration of phosphorus in the soil solution by studying the solubility products of the more important compounds of aluminium, iron and calcium. The potential maximum of phosphorus able to be sorbed by a soil was examined in relation to a mass balance equation and various sorption models. Prediction of phosphorus concentration versus time and space for a given set of initial and boundary conditions was made by measurement of a time dependent sorption isotherm used with a mass balance analysis.

*Phosphorus, *Phosphorus compounds, *Soil management, Eutrophication, Sorption, Waste water disposal, Environmental effects, Analytical techniques, Pollutant identification

Land treatment

J242
FATE OF WASTEWATER BACTERIA AND VIRUSES IN SOIL,

Gerba, C. P., Wallis, C., and Melnick, J. L.

Baylor College of Medicine,
Houston, Texas,
Department of Virology and Epidemiology.

Journal of the Irrigation and Drainage Division-ASCE, Vol. 101, No. IR3, p 157-174, September, 1975. 5 tab, 63 ref.

With increasing use of land application for domestic waste water disposal, mechanisms involved in the removal of microorganisms present in the soil must be understood to minimize possible public health problems. A review of current research on the fates of bacteria and viruses in the soil is presented. Results of both laboratory and field tests for various microorganisms were described. In most cases, it appeared that the survival of bacterial pathogens in soil is limited to less than 2-3 months in temperate climates. However, application of sewage in the long range could result in their accumulation at the soil surface where they will be concentrated. Runoff from such areas must be controlled so as not to pollute surface waters. The survival of enteric bacteria in soil is dependent upon soil moisture content, temperature, pH, and nutrient availability. Bacteria removal seems to occur primarily at or near the soil surface by straining as well as by sedimentation and adsorption. Removal of viruses occurs largely by adsorption; degree of retention of viruses by soil particles is influenced by salt concentration, pH, presence of organic matter, flow rates, and the chemical composition of the soil. Because laboratory studies on viral and bacterial movement through soil are conducted under relatively constant conditions, they should be evaluated very carefully.

*Waste water treatment, *Waste disposal, *Sewage disposal, *Microorganisms, Bacteria, Viruses, Groundwater, Surface waters, Water pollution effects

J243
EFFECT OF HALOGENS AND OZONE ON SCHISTOSOMA OVA,

Mercado-Burgos, N., Hoehn, R. C., and Holliman, R. B.

Virginia Polytechnic Institute and State University,
Blacksburg,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 10, p 2411-2419, October, 1975. 4 fig, 2 tab, 16 ref.

Basic technical data were compiled on the effectiveness of common disinfectants applied at different dosages and contact times against the ova of Schistosoma mansoni. These data on chlorine, iodine, bromine, and ozone, were evaluated for design of disinfection units in future waste water treatment plants. Schistosomias is a human parasitic disease that has been linked to the discharge of waste water into waterways; however, few treatment plants in high incidence areas practice disinfection. In this investigation, S. mansoni ova suspended in secondary treated waste water effluents were exposed to the various disinfectants. Although the exact mechanism is not known, chlorine was more effective than either iodine or bromine in schistosome ova elimination. In tests for ozone disinfection, difficulties were encountered because the ozone generating method was extremely inefficient. Additionally, the ozone demand of waste water made disinfection of schistosome ova by ozone difficult. Only at tests with 40 mg/liter was a complete elimination of the schistosoma possible. However, ozone does not form any toxic addition products with constituents of waste water as halogens do, and free ozone residuals are short-lived, especially in water containing organics.

*Ozone, *Waste water treatment, *Disinfection, *Public health, *Chlorine, *Bromine, *Iodine, Halogens, Toxicity, Effluents, Water pollution sources

*Schistosoma mansoni

J244
PUMPING AND THE EMPINGHAM SCHEME,

Water and Waste Treatment, Vol. 18, No. 8, p 18-19, August, 1975. 3 fig.

The largest man-made reservoir in Great Britain is under construction near the village of Empingham. When completed, it will hold 27,300 million gallons of water, and provide a reliable supply of 50 mgd. Because the area is one of very low residual rainfall, a pump storage project must be implemented. The sources of water supply available are the Rivers Welland and Nene, which have wide flow rate variations. In order to take advantage of high flow rates when they occur, a pumping plant with a total capacity of 193 mgd has been installed. An aqueduct 13 miles long was also constructed, which leads from the reservoir to the farthest intake. As the aqueduct crosses the valleys of the Nene and Welland Rivers, the intervening watersheds are connected by means of pumping mains and tunnels. The final tunnel section terminates in two 33 ft diameter shafts at the foot of a dam. These shafts have been designed to accomodate 12 shaft driven borehole pumpsets. A pumping station has also been built at the foot of the dam on the side adjacent to the abstraction shafts to boost raw water at a rate of 36 mgd to a treatment works at Wing. This treatment facility, operated by the Northampton Water Division, will be equipped with two vertical Uniglide sets (variable speed pumps) which may operate under varying head and quantity conditions, depending upon the output required.

*Water supply, *Reservoirs, *Pumping, *Pumps, Equipment, Rivers, Treatment facilities, Water treatment, Aqueducts

Pump storage, Northampton (Great Britain)

842

J245
STUDIES ON SUBSURFACE MOVEMENT OF EFFLUENT FROM PRIVATE SEWAGE DISPOSAL SYSTEMS USING RADIOACTIVE AND DYE TRACERS, PART 2, 1973-74,

Brandes, M.

Ontario Ministry of the Environment, 1975. 54 p, 7 fig, 3 tab, 17 ref, 4 append.

Radioactive and dye tracers, Tritium, 32P, and Fluorescein, were used to study the underground movement of septic tank effluents from 4 individual sewage disposal systems towards the receiving bodies of water, Lake Couchiching and Little Lake, both in Canada. Tritium was an excellent tracer, however, radioactive phosphorus and fluorescein are not recommended as tracers in soil. The sewage disposal systems consisted of septic tanks and tile fields. The three sites on Lake Couchiching were built on clayey-silt soil. The site on Little Lake was built on imported sand. The tile fields produced a relatively high removal of phosphorus, 78% in sand fields and 90% in clayey-silt fields. The sewage disposal systems had no effect on the concentration of nitrates in groundwater. The concentration of free ammonia in groundwater from bore holes drilled in clayey-silt soil was lower than from holes in sand. Some part of the ammonia is retained by the finer grain size soil. All of the sewage disposal systems satisfactorily removed coliform organisms. Flooding of the tile fields had no harmful effect on the concentration of pollutants in groundwater.

*Waste water treatment, *Waste water disposal, *Tile drains, *Septic tanks, Tracers, Phosphorus, Path of pollutants, Soils, Water pollution sources, Tracking techniques, Radioactive techniques

Radioactive tracers

J246
WASTE-PRODUCT POLLUTION OF BODIES OF WATER AND WASTE-WATER PURIFICATION,

Schneider, P. E. M.

NASA Technical Translation NASA TT F-15,934, September, 1974. 28 p, 34 ref. Translated from Max-Planck-Institut fuer Stroemungsforschung, Goettongen, West Germany, Report 2/1974, 53 p.

A literature review is presented on the problems of pollution of water bodies by wastes, and on waste water purification. The review is intended to provide examples of problems involved in water pollution and the treatment of waste water, and to encourage the formulation of further questions. Currents in bodies of waters are important in the self-purification of the water. Oxygen dissolved at the surface of waters is transported by turbulent exchange and convection to deeper water, therefore, the quantity of oxygen available to organisms at these deeper levels which participate in self-purification is a function of current conditions. Discussion is presented on the seven categories of water pollution: solid, liquid, gaseous, thermal, photo, chemical, and biological. These types of pollution can be corrected by solid, liquid, gaseous, thermal, photo, chemical, and biological purification methods. The quality of general-purpose and potable water decreases with time because only part of the pollutants are removed by present purification methods. Surface waters in lakes and rivers must be used as additional water purifiers in the future. Studies on currents in rivers, lakes, and oceans and their possibilities for the maintenance and improvement of good river and potable water supplies are being planned.

*Waste water treatment, *Water pollution, *Bodies of water, *Reviews, Currents, Rivers, Lakes, Oceans, Self-purification

J247
THE PLANNING AND CONSTRUCTION OF POTABLE WATER WORKS IN RELATION TO THEIR OPERATION (EL PROYECTOR Y CONSTRUCCION DE OBRAS DE AGUA POTABLE EN RELACION CON LA OPERACION),

Flores-Sousa, G.

Recursos Hidraulicos, Vol. 4, No. 2, p 204-213, 1975. 4 fig.

The General Direction of the Operation of Potable Water and Sewerage Systems of Mexico feels that there is a need for reviewing the demand, customs, economic possibilities, and standards of operation of water treatment in order to obtain directives, data, and further experience. This information will be used to perform projects and construct water works in a more economical and functional manner to provide for the optimum utilization of the available hydraulic, technical, and financial resources. Rigid standards to be followed in the planning and construction of water works are not desirable. Instead, engineers and technicians in the field of water engineering should conscientiously study the problems and formulate specifications and instructions applicable to Mexico and other developing countries. The General Direction of the Operation of Potable Water and Sewerage Systems has established a procedure of systematic observation in towns of the Republic with different living conditions, number of inhabitants, climate, type of water supply, and socioeconomic aspects. This information will be made available to designers of new water works and others concerned with the improvement of existing treatment facilities. The information should also identify areas in which operation can be improved and currently used techniques can be modified or adapted.

*Water treatment, *Water works, Foreign research, Planning, Construction, Operation

Mexico

J248
STUDY OF FLUORINE IN THE UKRAINE AND THE ENDEMIC FLUOROSIS CONNECTED THEREWITH (Izuchenie ftora na Ukraine i svyazannogo s nim endemicheskogo flyuroza),

Gabovich, R. D., and Stepanenko, G. A.

Gigiena i Sanitariya, No. 7, p 13-16, 1975. 1 fig, 3 tab.

A dynamic study has been conducted for the past 25 years on the fluorine content in the soils, natural water (both ground and artesian), foodstuffs, and daily food rations of the populations in four geochemical zones of the Ukraine in connection with the shifts in the incidence of dental fluorosis. The data of this study is presented. The causes of the decreases of the incidence of dental fluorosis in the case of a comparatively stable fluorine content in the environment are discussed.

*Water supply, *Fluorine, Soils, Public health, Water sources, Groundwater, Artesian wells, Foods

Dental fluorosis

J249
HYGIENIC ASSESSMENT OF THE FLOTATION REAGENT T-66 IN THE WATER BODIES AND ITS MAXIMUM PERMISSIBLE CONCENTRATION (Gigienicheskaya otsenka flotoreagenta T-66 v vodo vodoemov i ego predel'no dopustimaya kontsentratsiya),

Kudrin, L. V., Pavlenko, S. M., Zamyslov, S. C., and Sergeev, A. N.

Gigiena i Sanitariya, No. 7, p 43-46, 1975. 1 fig, 1 tab.

The flotation reagent T-66 is a possible source of pollution in bodies of water. A complex series of hygienic investigations was performed in order to determine the features of the effect produced by T-66 on the organoleptic properties of water, and the sanitary regimen of the water body. Its effects on warm-blooded animals under conditions of acute and chronic sanitary-toxicological experiments were determined with the use of a wide range of modern methods. A special toxicological index of noxiousness was proposed for the hygienic standardization of the flotation reagent in water bodies. A concentration of the substance at a level of 0.2 mg/liter was found to be subthreshold in warm-blooded animals; the concentration of 2.0 mg/liter was found to be threshold. The maximum permissible concentration of the flotation reagent T-66 is 0.2 mg/liter.

*Water pollution sources, *Water pollution, Toxicity, Bodies of water, Standards, Glossary, Public health

Flotation agent T-66, Threshold concentration, Maximum allowable concentration

J250
IMPACT OF THE SAFE DRINKING WATER ACT,

McDermott, J. H.

Office of Water and Hazardous Materials,
U.S. Environmental Protection Agency,
Washington, D. C., Water Supply Division.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 3-18. 3 tab.

The Safe Drinking Water Act was signed into law in December, 1974. However, further legislation is being debated because current standards have not been uniformly applied. A reassessment of the current technology is needed, particularly with respect to small systems. Data for the past few years were collected and indicated that many drinking water systems lack adequate collection and treatment facilities, have poorly trained and/or part-time employees, are infrequently inspected by the state or county, and are poorly operated and maintained. Additionally, there is a substantial lack of public awareness of the problems. The drinking water standards were defined in terms of the roles of federal, state, and local utilities. Technical assistance has been given by the federal government for research related to the "cause, diagnosis, treatment, control, and prevention of physical and mental disease" of man, and to providing a dependable safe drinking water supply. Pending legislation both in the Senate and in the House was discussed. It was noted that the House bill would authorize treatment standards in cases where lack of measurement techniques and/or firm health effects data would otherwise prevent the establishment and enforcement of a constituent standard. It was concluded that the most immediate legislative challenge is to extend or modify existing practices for application in small systems. In addition, it was hoped that the research conducted under the Safe Drinking Water Act will improve the quality and dependability of United States water supplies.

*Potable water, *Legislation, Water quality standards, Water supply, Water treatment, Treatment facilities, Federal jurisdiction, Research

J251
THE DEVELOPMENT AND APPLICATION OF THE 1974 DRINKING WATER STANDARDS,

Lee, R. D.

Office of Water and Hazardous Materials,
U. S. Environmental Protection Agency,
Washington, D. C., Water Supply Division.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 19-33. 1 tab, 4 ref.

Provisions of the 1974 Safe Drinking Water Standards were discussed, viewing the act as a revision of the 1962 Public Health Service Drinking Water Standards. The proposed new standards with the greatest impact on water supply utilities and regulatory agencies were said to be: the reduction of the turbidity limit from 5 units to one unit and its reclassification as a health-related constituent; the addition of a mercury standard of 2 micrograms per liter; the addition of several pesticides for which monitoring will be required; and, the concept of radiation dose to replace the previous concentration of radioactivity in water. A more detailed list of changes in the new standards is provided in tabular form. Changes were made in standards for bacteria, chlorine residual, viruses, trace substances, and radioactive substances. The impact of the new standards and guidelines on water utilities is dependent upon procedures for surveillance and monitoring as defined by the individual states. The Standards emphasize the continuing need to evaluate alternative sources and to choose those which present the minimum risk of contamination by waste waters with impurities which might be a health hazard. Over a seven year period, analyses of all of the 240,000 water systems (40,000 conventional and 200,000 which serve the travelling public) in the United States are planned. Additional research on health effects and treatment technology is needed before standards can be developed that can adequately protect human health on a long range basis.

*Potable water, *Legislation, *Public health, Water quality standards, Water supply, Water treatment, Water pollution effects, Monitoring, Pollutant identification, Turbidity, Mercury

J252
NEW ENVIRONMENTAL HEALTH PROBLEMS IN WATER SUPPLY,

Hall, D. P.

National Institute of Environmental Health Services,
Research Triangle Park, North Carolina.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 34-37.

The possible toxic effects of newly produced chemicals on public health, when introduced into public water supplies, are of great concern. Because between 500 and 1,000 new chemicals are introduced into commerce each year, the potential harm of these has not been measurable. Because there is no systematic mechanism for knowing the processes by which these new chemicals are produced, it cannot be predicted when intermediates and by-products will appear in the environment. Two well-known examples of this are polychlorinated biphenyls, which were accidentally discovered in carcasses of birds, and phthalic acid esters, which also appeared suddenly in the environment. Thus, the first major problem was defined as the need to develop systematic mechanisms to monitor the production of new and old chemicals, including knowledge about chemical identity, production volumes, processes intended uses, and by-products. Simple, rapid presumptive toxicity tests must be designed to estimate their toxicity, with more detailed testing for the chemicals which appear to be most hazardous. Finally, the meaning for human health of the toxicity tests must be understood, and quantitative dosages must be better defined.

*Chemical industry, *Toxicity, *Public health, *Environmental effects, Potable water, Pollutant identification, Analytical techniques

J253
EPIDEMIOLOGY OF WATERBORNE DISEASE IN THE UNITED STATES 1971-1973,

Hughes, J. M., Hanson, M. H., and Craun, G. F.

U. S. Public Health Service,
Atlanta, Georgia,
Bureau of Epidemiology, Center for Disease Control.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 38-55. 4 fig, 7 tab, 30 ref.

Because waterborne diseases in the United States must be recognized and investigated before they are officially reported to the Center for Disease Control (CDC) or to the EPA, true incidences are difficult to estimate. However, between 1971 and 1973 the reported number of such outbreaks had increased to an average of 24 per year. Waterborne outbreak was defined as the occurrence of illness in two or more persons after drinking water which is implicated epidemiologically as the vehicle of transmission of the illness. Tables were provided on the types (sewage poisoning, Hepatitis A, Shigellosis, Giardiasis, Chemical poisoning, Typhoid fever, and Salmonellosis, in order of decreasing frequency) of outbreaks and the number of cases for 1971, 1972, and 1973. Water systems were classified as municipal, semi-public, and individual. Types of deficiencies found to cause disease in these systems included untreated surface water; untreated groundwater; treatment deficiencies; and deficiencies in the distribution system. A large proportion of the outbreaks occurred in semi-public systems, particularly in summer recreational areas. Case studies for five outbreaks were reviewed. These involved: typhoid in a Florida migrant labor camp; Shigellosis in a Stockport, Iowa, school; Hepatitis at a rural school in Alabama; arsenic toxicity in a Minnesota well; and Shigellosis on a Caribbean cruise ship. To decrease the incidence of waterborne disease it is recommended that local, state, and federal agencies establish effective monitoring and maintenance systems for municipal and semi-public systems and that future outbreaks be reported.

*Public health, *Pollutant identification, *Epidemiology, *Water pollution effects, *Human diseases, Toxicity, Water supply, Water delivery, Shigella, Salmonella

*Sewage poisoning, *Center for Disease Control, *Hepatitis, *Typhoid, Arsenic toxicity, Waterborne diseases

J254
ENTERIC VIRUSES AND DRINKING WATER SUPPLIES,

Sobsey, M. D.

North Carolina University,
Chapel Hill,
Department of Environmental Sciences and Engineering.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 56-70. 1 tab, 45 ref.

Very little quantitative information is available on enteric virus levels in United States drinking water, although it is known that these viruses are present in sewage and sewage-contaminated natural waters. Enteric viruses have also been isolated from public water supplies in France and South Africa. Documentation on the epidemiology of waterborne transmission of enteric virus disease has been limited to outbreaks of hepatitis type A. These outbreaks usually resulted from inadequate treatment of private or semi-public supplies or from contamination in the distribution systems of public supplies. Because of the inadequate recognition and reporting of viral disease, it is difficult to recognize whether other waterborne disease outbreaks might have been due to enteric viruses. Both laboratory and field studies have demonstrated that a conventional sewage treatment system with primary and secondary treatment plus effluent chlorination will not reduce the enteric virus concentration by more than about 99%. Various types of water treatment--chemical coagulation, and flocculation, water softening precipitation, rapid sand filtration, chlorination, or ozone--will produce a reduction in virus concentration of 6 to 7 orders of magnitude. Detection methods have been developed which may be used to determine small amounts of viruses in up to 100-gal volumes of drinking water. These methods include flow-through filter adsorption-elution systems and ultrafiltration. Enteric virus drinking water standards have not yet been set, and surveillance studies are recommended to determine if current microbial standards are adequate to protect the public health.

*Epidemiology, *Viruses, *Potable water, Sewerage, Distribution systems, Water treatment, Laboratory tests, Public health, Water pollution effects

J255
ORGANIC CHEMICALS IN DRINKING WATER,

Spath, B. P., and Ongerth, H. J.

California State Department of Health,
Berkeley,
Water Sanitation Section.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 71-79. 14 ref.

Planned reuse of waste waters has increased, particularly in California where waste water reclamation includes crop irrigation, landscape-golf course irrigation, industrial water supply, recreational impoundments, and groundwater recharge. California encourages waste water reuse where there is no hazard presented to the public health. However, much concern has been expressed because of the lack of information about the risks of chronic illness from long-term exposure to residual organics that remain in treated waste water. The toxicity of residual organic chemicals has been measured in laboratory animals, but extrapolations to humans are difficult and uncertain. Plans to use renovated waste water to augment domestic sources as well as proposals for using renovated waste water for industrial purposes are described. Both direct and indirect waste water reuses imply a burden of responsibility. The identity of organic residues in renovated sewage has not been completely established. Further emphasis should be placed on determining organic constituents and identifying health effects, and caution has been urged in future waste water reuse.

*Recycling, *Water reuse, *Waste disposal, *California, *Public health, Water supply, Organic compounds, Reclamation, Sewage disposal, Sewerage, Environmental effects

Waste water reuse

J256
OVERVIEW OF PROBLEMS ASSOCIATED WITH INORGANIC CONTAMINANTS IN DRINKING WATER,

Craun, G. F., and McCabe, L. J.

U. S. Environmental Protection Agency,
Cincinnati, Ohio,
National Environmental Research Center.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 80-98, 3 tab, 37 ref.

An overview of problems, both acute and chronic, associated with inorganic drinking water contamination is presented. Between 1946 and 1972, 19 outbreaks and 279 cases of waterborne illness were reported due to chemical poisoning. While this represents only 3% of the total waterborne disease outbreaks documented for this period, the mortality rate was 3.4% (compared to 0.05% for all waterborne illness). These poisonings involved fluoride, selenium, arsenic, and copper. Such statistics are useful for implementing prevention measures. However, greater concern has been expressed on the effects of low-levels of contaminants in drinking water on chronic disease mortality. Contradictory results have been obtained from several studies correlating cardiovascular diseases and the mineralization (hardness or softness) of drinking water supplies. Soft water is generally more corrosive and may contain more metal contaminants from water piping; however, hard water contains larger amounts of calcium and magnesium. Extensive research on water quality and cardiovascular disease is on-going. The sources of metals in drinking water have been investigated and distribution sampling for water supplies in Boston and Seattle are illustrated in tabular form. Mutagenic and carcinogenic effects were also postulated, and research on the removal of trace inorganic substances by water treatment processes is being conducted.

*Potable water, *Human disease, *Metals, *Inorganic compounds, Water treatment, Hardness (water), Water pollution effects

J257
EVALUATING STATE DRINKING WATER QUALITY SURVEILLANCE PROGRAMS,

Taylor, D. H., and Hutchinson, G. D.

U. S. Environmental Protection Agency, Region IV,
Atlanta, Georgia,
Water Supply Branch.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 99-116. 3 fig, 5 tab, 10 ref, 1 append.

The results of studies in four southeastern states on water supply conditions have been summarized. Data were provided for Kentucky, Georgia, Tennessee, and a fourth state whose name has not yet been released. The evaluation included a review of basic water supply statutes, regulations, and program policies. The activities, responsiveness to problems, personnel, and management were examined. The three general types of water supply systems were public water supply, small public water systems (serving non-resident public or fewer than the minimum resident requirement), and private, single family systems. Public and semi-public water supplies were evaluated for failures to meet bacterial standards, recommended chemical standards, and mandatory chemical standards. Public water supplies were also rated on their failure to fluoridate at correct levels. Other surveillances included bacterial sampling, chemical sampling, cross connection programs, and the existence or lack of annual State Agency inspection. Percentages of supplies having each characteristic were shown in three tables. Overall, water supply practice was found deficient in all four states, in terms of bacterial and chemical standards, treatment and storage facilities, and operator-training. It was suggested that State legislatures need to make greater commitments to the water supply industry to expand margins of safety in water quality and supply.

*Water supply, *Public health, *Standards, *Legislation, *Potable water, Water quality, Sampling, Kentucky, Georgia, Tennessee, Personnel, Water treatment

J258
STRATEGIES FOR ASSURING HIGH QUALITY DRINKING WATER IN THE FUTURE,

Okun, D. A.

North Carolina University,
Chapel Hill,
Department of Environmental Engineering.

In: The State of America's Drinking Water, September 26 and 27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 117-123.

Based on findings of several recent surveys, the smaller, private water supply systems in the United States do not have adequate resources in terms of facilities, manpower, or funds to provide high quality service. The United States' problems are of a larger scale than Great Britain; however, recent reorganization in England was cited as a valuable comparison. The new (since April, 1974) Regional Water Authorities System in Britain was described in detail. It was conceded that in the United States, particularly in smaller communities, the quality of waste water treatment facilities operation has not matched investments. In addition, 75% of the construction costs of municipal interceptors and treatment works are met by federal grants, with state governments adding 10 to 15%. Thus, local governments have been reluctant to initiate projects until they are assured grant support. The construction grant program covers only capital costs, thus promoting facilities that maximize construction costs and minimize operating costs, rather than optimizing design. Other problems include the requirement for uniform treatment, disregarding local needs. With the diversity of United States' water supplies, integrated regional management is highly urged.

*Potable water, *Water supply, *Regional development, Legislation, Treatment facilities, Construction costs, Water treatment, Personnel, Administration

Regional Water Authorities System (Great Britain)

J259
PROBLEMS IN SMALL WATER SYSTEMS,

Rundgren, C. E.

North Carolina Department of Human Resources,
Raleigh,
Division of Health Services.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 124-134. 2 fig.

Problems of small water supply systems were discussed, with a focus on North Carolina systems. Three types of problems were evaluated: financing, planning, and operation, maintenance, and management. Financial problems centered around funding of expansion and improvement rather than initial construction. Approaches in North Carolina to solve financing included a Farmers Home Administration program for non-profit water associations. Other alternatives were the sale of a water system to the governmental system or to a privately owned public utility, thus reducing the number of smaller systems. Problems of inadequate planning comprised: improper well site location; inadequate storage capacity; supply capacity source inadequate for demand; distribution pipeline too small; and lack of water quality control provision. Proper development, engineering consultation, and the meeting of 1972 design, construction, and disinfection standards was recommended. Problems of operation, maintenance, and management related to the lack of experience and/or trained personnel, funds for depreciation and expansion, and laboratories for water quality control. While no solutions were available for privately owned water systems, the North Carolina Clean Water Bond Act of 1971 provided funds for municipal water systems. Benefits of partially completed projects under this Act were described.

*Water supply, *North Carolina, *Costs, Construction, Planning, Engineering, Management, Personnel, Water quality control, Wells, Legislation

Farmers Home Administration (FmHA), North Carolina Clean Water Bond Act

J260
FINANCIAL CONSIDERATIONS FOR RURAL WATER SYSTEMS,

Rose, C. W.

U. S. Department of Agriculture,
Washington, D. C.,
Farmers Home Administration.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 135-142.

The Farmers Home Administration (FmHA) has actively been involved in the design and financing of rural water systems for several years. Engineers in the FmHA found it nearly impossible for small isolated communities to meet the rigid standards of urban areas in terms of fire protection, storage capacity, or reserve flows. Successful FmHA systems in North Dakota, Iowa, Oklahoma, and South Dakota were described. These systems recognized potential uses of new construction materials, such as plastic pipes, multimedia filters, and hydropneumatic pressure systems. Because of increasing construction costs, it recommended that rural areas re-evaluate flow calculations and unworkable design guides, with particular emphasis on avoiding unnecessary overdesign.

*Construction costs, *Rural areas, *Water supply, Design criteria, North Dakota, Iowa, Oklahoma, South Dakota

Farmers Home Administration (FmHA), Water storage, Overdesign

J261
PROBLEMS OF INDIVIDUAL SUPPLIES,

Whitsell, W. J., Hutchinson, C. D., and Taylor, D. H.

U.S. Environmental Protection Agency,
Washington, D. C.,
Water Supply Division.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 143-157. 5 fig, 20 ref.

The EPA has estimated that 50 million people in the United States depend upon individual water supply systems. It was also estimated that about 40% of these supplies do not meet safety standards. Studies in Georgia, Tennessee, and Kentucky were conducted; results of coliform tests were illustrated in five graphs. The most common deficiencies, as determined from these studies and other field data were: insufficient and substandard well casing; inadequate formation seal between the well casing and bore hole; poor welding of casing joints and indiscriminate perforation of casing; lack of sanitary well covers; reliance on a dug well; and use of well pits to protect from freezing. For safe individual home water supplies, a list of well construction recommendations was prepared. It included: the construction of wells by drilling, driving, or jetting; use of schedule 40 or heavier steel casing and water-tight welded or threaded-and-coupled joints; installation of solid casing, at least 5 feet below the lowest anticipated static water level; filling of the annular case between the bore hole and casing with a suitable sealant; minimum grouting thickness of the annular space deeper than the deepest frost penetration, sealing out water, of 1 1/2 inches; and proper covering and ventilation.

*Water supply, *Potable water, *Water quality standards, Georgia, Tennessee, Kentucky, Wells, Coliforms, Water pollution sources

Individual water supplies

J262
LEGAL CONTROLS FOR PROTECTING UNDERGROUND SOURCES OF DRINKING WATER,

Walker, W. R., and Cox, W. E.

Virginia Water Resources Research Center,
Blacksburg.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 159-167. 34 ref.

Proposed legislation, particularly the House of Representatives bill H. R. 13902, emphasizes groundwater as a source of water supply. Passage of this legislation would improve the existing situation by giving federal regulation of state underground injection control programs. However, even adoption of this bill would give separate policy provisions for gravity flow drainage wells, as opposed to injection wells. Other sources of groundwater contamination, such as surface activities, would remain unregulated under the proposed law. Legal controls currently in effect were reviewed. It was noted that there is no comprehensive program for control of underground sources of drinking water and that basic authority may best be established at the state level. It was also suggested that the scope of necessary controls may have to be expanded to include land use in addition to the restrictions on waste disposal.

*Legislation, *Groundwater, *Water pollution sources, *Waste disposal, Water supply, Potable water, Land use, Injection wells, Drainage wells, Water quality control

J263
EMERGENCY SUPPLIES,

Bell, F. A., Jr.

U. S. Environmental Protection Agency,
Washington, D. C.,
Water Supply Division.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 168-177. 1 tab, 7 ref.

Problems of emergency water supplies were examined. Two actual case studies and one hypothetical example resulting from earthquake disasters in urban areas were detailed. No major problems occurred in providing the population of 14,000 with emergency water in San Fernando, California, in February, 1971. In a Managua, Nicaragua earthquake in December, 1972, however, there were 100,000 persons affected. Their program of tank truck water deliveries was effective in sustaining life but was slow and entailed problems of availability and safe water treatment. A hypothetical earthquake of the Hayward Fault (San Francisco Bay, California) would ruin a water supply system serving over one million people. Problems would be in distribution, rather than treatment or availability of water. Practical steps were outlined for federal, state, and local governmental preventive measures. These included: assessing available alternative water supplies; taking inventory of possible sources of trucks to carry emergency water; and establishing mutual aid agreements with nearby utilities.

*Water shortage, *Water supply, *Earthquakes, California, Water treatment, Distribution systems

Emergency water supply, Nicaragua, Urban areas

J264
AN APPROACH TO PROVISION OF RURAL WATER SUPPLIES,

Zimmerman, S. S.

National Demonstration Water Project,
Washington, D. C.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 178-189. 1 tab.

The National Demonstration Water Project (NDWP) was organized in 1971 and was initially funded by the Office of Economic Opportunity. Its original goal was to bring adequate water facilities to the five rural counties surrounding Roanoke, Virginia. By 1973, the project had grown to include six affiliate projects, from Florida to New Mexico. The basic goals of the NDWP are: to build over $30 million worth of facilities by 1980, through the six affiliates; to design and test models for rural water and sewer projects; to gain technical and non-technical expertise for the development of such projects; and to organize a national alliance to continue improving rural water and sewer facilities after the NDWP program is over. Problems of financing, operation, maintenance, and regulation in rural systems were detailed. The present methodology of the NDWP program involves three types of field approaches. The affiliate projects (in West Virginia, Virginia, South Carolina, Arkansas, New Mexico, Florida) are all in low-income rural areas. The Virginia and New Mexico projects are non-profit, run by user-owned water-sewer companies. The West Virginia, South Carolina, and Arkansas projects were also developed by non-profit companies, but are managed by public agencies. The Florida project was developed by a cooperative-controlled non-profit agency, and is supported by a rural electric cooperative. On the national level, the NDWP coordinates the various affiliate projects and conducts research for publications on state and federal policies and on rural water-sewer development practices.

*Water supply, *Rural areas, *Sewers, Virginia, West Virginia, South Carolina, Arkansas, New Mexico, Florida, Management, Regional development, Publications

852

J265
DESIGN OF WATER TREATMENT FACILITIES,

Prendiville, P. W.

Camp Dresser and McKee, Incorporated,
Boston, Massachusetts.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 190-198.

A brief overview was presented of currently used methods in the water treatment processes. Topics included: pilot scale investigations; flexibility in design; flocculation and chemical coagulants; sedimentation; filtration; instrumentation and control of the processes; and sludge and waste water treatment and disposal. An emphasis was made on the choice and application of chemicals and the design of the flocculation, sedimentation, and filtration processes. The use of direct filtration and economic advantages of that method for the treatment of some water supplies was also discussed. The use of pilot plants before building treatment facilities was strongly urged, particularly for filtration rates, degree of flocculation, and the choice of chemical applications. To allow for future plant expansion, a recommendation was made that design be flexible. Decisions of when to automate water treatment facilities were considered, particularly for the filtration process, chemical processes, and hydraulic flow-through. In larger plants, the logging of data, control loops, and maintenance programs may also be computerized. In considering the waste treatment plant, the disposal of solids was seen as a major design problem.

*Water treatment, *Pilot plants, *Treatment facilities, *Design criteria, Control systems, Automation, Computers, Economics

J266
WATER RATES: AN ASSESSMENT OF CURRENT ISSUES,

Hanke, S. H.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 199-218. 2 fig, 18 ref.

Rate-making policies for water utilities in the urban United States were assessed. Changes have developed, from flat rates to metered rates, with a declining block structure (the first blocks of water consumed during a billing period are purchased at a given rate, with successive larger blocks costing less). This declining block structure is being gradually eliminated and utilities are considering a change to a seasonal rate structure system, whereby rates would be higher in seasons of high cost, high use. The theory of marginal cost pricing was described. It was argued that there are several defects in the actual design of pricing policies, and that historical average costs that are used are not marginal or incremental. Rate-making policies were also criticized for using variable costs not correlated with the demand for either capacity or water. Important new trends in rate-making included computer simulation models to evaluate rate structures and their impact on water use, sewer flows, costs, revenues, and required investment. New changes in rate structures were attributed to a compromise between industry and economists' views as well as to environmental regulation.

*Costs, *Water demand, *Water rates, Economics, Computers, Model studies, Marginal costs, Water supply, Environmental effects

Water consumption, Cost allocation

J267
TRAINING OPPORTUNITIES AND THE SAFE DRINKING WATER ACT,

Shaw, R. E., Jr.

Public Works,
Greensboro, North Carolina.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 219-223.

The various developments in the training of operators, chemists, clerical personnel, maintenance personnel, utility engineers, and managers in the water treatment profession were described. The American Water Works Association (AWWA) Education Program, which has been on-going for six years, has been very successful. One AWWA course in Emergency Planning for water utility management included disaster effects, vulnerability assessment, protection measures, and emergency operations planning. Another AWWA seminar on accident prevention has incorporated OSHA requirements and methods to set up an effective program within the utility. One-day seminars have been held since 1973, including the topics of: developing water rates; OSHA compliance and accident prevention; upgrading existing water treatment plants; enhancement and control of reservoir water; and public information/public relations. A project was funded by HEW for the Oklahoma Research Foundation to obtain data in order to provide model job descriptions, performance standards, work-load indicators, and staffing guides. Other developments include the revision of the Water Supply Visual Aids Index and the compilation of the Water Utility Training Directory. AWWA training manuals and materials have increased in circulation and a section of these publications are being translated and printed for distribution in foreign countries, beginning with a program in Brazil.

*Personnel, *Training, *Professional personnel, *Water rates, Water treatment, Water pollution control, Publications

Public relations, Emergency water planning, American Water Works Association (AWWA)

J268
MATHEMATICAL OPTIMIZATION OF WATER SUPPLY SYSTEMS STATE OF THE ART,

Deininger, R. A.

Michigan University,
Ann Arbor,
School of Public Health.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 224-234. 100 ref.

A state-of-the-art review is presented on the tools and techniques available to the systems analyst for solving water supply problems. An extensive bibliography is presented, divided into: general water supply network references; design of well fields; water distribution systems; and models of treatment plants (staging). By using mathematical models and optimization techniques, such as linear programming, more alternatives may be analyzed at each level of decision making, and assumptions or estimations of the influence of economic, political, and environmental uncertainties may be tested. Such techniques also provide a communications tool for professionals involved in water supply planning. The basic steps of a systems analysis are outlined. Types of techniques used are: linear programming; nonlinear programming; dynamic programming; integer programming; stochastic programming; geometric programming; network techniques PERT/CPM; simulation techniques; and classical optimization techniques. Although any one of these mathematical modeling and computational techniques increases the capability of generating information to be used in the decision-making process, it was emphasized that these are only tools, and cannot by themselves solve water supply systems problems. Additionally, one must be careful in applying model solutions to real situations.

*Reviews, *Model studies, *Computers, Mathematical models, Linear programming, Simulation analysis, Water supply, Systems analysis, Treatment facilities, Water treatment, Decision making

J269
WATER DEMAND FORECASTING--SOME CONCEPTS AND TECHNIQUES,

Lauria, D. T.

North Carolina University,
Chapel Hill,
Department of Environmental Sciences and Engineering.

In: The State of America's Drinking Water, September 26-27, 1974, Chapel Hill, North Carolina, Research Triangle Universities, p 235-253. 8 fig, 20 ref.

Three categories may be used to forecast water demand: locational classification; consumptive use; or usage classification (purpose for which the water is demanded). The third of these is the most commonly used basis for forecasting. Such purposes include irrigation, cooling, commercial supply, residential supply, street washing, and fire protection. The classic economic theory of demand was presented. This theory identifies the basic variables underlying demand, including social tastes and preferences. Most predictions, however, are based on future requirements or needs rather than demand. Three methods used--time series models, regression models, and input/output models--were outlined. It was concluded that the combination of economic theory and mathematical modeling will help investigators to understand and quantify fairly accurately the water demand phenomenon. However, most theory deals with static situations, and more time series analyses and projections of trends are necessary for future estimates.

*Forecasting, *Water demand, *Model studies, Mathematical models, Economics, Potable water, Water supply

J270
RESEARCH NEEDS IN THE CONTEXT OF OUR GOAL TO RESTORE AND MAINTAIN THE CHEMICAL, PHYSICAL AND BIOLOGICAL INTEGRITY OF THE NATION'S WATERS,

Bryan, E. H.

National Science Foundation, Washington, D. C.,
Environmental Systems and Resources.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 4-12. 6 ref.

The need for various kinds of research to solve water pollution problems is discussed. Both basic and applied research are relatively long-term projects that can be considered investments for the future. It is also important to invest in personnel training and research capability that will be available for implementation of needed additional research, design, construction, operation and maintenance of water pollution control facilities. However, in addition to basic and applied research, a type of research effort that is highly focussed on selected problems with the objective of solving these problems is needed. Problem-focussed research should be in reasonable balance with the more traditional types of basic and applied research. Problem identification, researchability and plans for the utilization of results are key factors in the selection of projects that are responsive to problem-focussed research. Since many of our water pollution problems, such as overflows of raw sewage from combined sewers and overloaded sanitary sewers, are big and expensive, the solutions must be highly cost-effective. There is also the problem of non-point source pollution, such as drainage from urban and agricultural areas. The use of current technologies to deal with current problems should cause powerful economic incentives for further research.

*Water pollution control, *Research and development, *Research priorities, Pollution abatement, Waste water treatment, Water pollution, Technology, Research facilities, Research equipment

J271
THE MEANING OF ULTIMATE DISPOSAL,

Dean, R. B.

National Environmental Research Center, EPA, Cincinnati, Ohio, Advanced Waste Treatment Laboratory, Ultimate Disposal Research Program.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 13-21.

Examples of some of the problems associated with the disposal of waste waters are discussed. Ideally, ultimate disposal includes processing and placing wastes where they will not degrade the environment. The main problem is where to place the wastes. Industrial wastes can be discharged, subject to control by permit after suitable purification; they can be evaporated; or they can be reused, after suitable purification. All three of these processes leave residuals; it is the disposal of residuals that is the real problem. If the pollutants in the waste water cannot be sold or a permit for their discharge to the surface or underground be obtained, then they must be put into permanent storage. A permanent lagoon is a permanent liability and not really a long-term solution due to the fact that the lagoons fill up. The wastes for permanent storage should be as concentrated as possible; ideally all of the water will be removed. However, the cost of drying must be balanced against the reduced cost of storage. Wastes can be converted into useful products only if the costs of conversion can be justified by the market value of the products. The cost of treatment can be greatly reduced by careful segregation of waste streams, so that the pollutants may be more easily recovered or the cost of drying reduced.

*Waste water disposal, *Waste water treatment, *Ultimate disposal, Municipal wastes, Industrial wastes, Pollution abatement, Waste disposal, Drying, Incineration, Solid wastes, Waste storage, Reuse, Recycling

J272
ZERO DISCHARGE OF INDUSTRIAL WASTEWATERS,

Rey, G., DesRosiers, P., and Lacy, W. J.

Office of Research and Monitoring, EPA, Washington, D. C., Technology Division, Industrial Pollution Control Section.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 22-41. 3 fig, 4 tab, 26 ref.

The 1972 Federal Water Pollution Control Act, PL 92-500, states that the discharge of pollutants into navigable waters must be eliminated by 1985. The major goals of the Environmental Protection Agency's industrial research and development program include research into water reuse and product or by-product recovery methods. Because industrial water quality requirements for reuse are less stringent than for municipal supplies, direct industrial water reuse (closed-cycle systems) should be technically feasible and economically achievable earlier than comparable municipal water reuse systems. Waste water reuse is a resource conservation measure and a method of pollution abatement. By-product recovery and utilization techniques can reduce the net cost of waste water treatment and hopefully will become less expensive than disposal. Recycled water is valuable because of intake water supply shortages, increasing water supply and water treatment costs, and rising municipal sewerage charges. The recovery of usable water and thermal energy are the main techniques of reducing overall waste treatment costs. To implement water recycling at an industrial plant it is necessary to determine major water use requirements and to establish water quality requirements. A general planning guide for an industrial water reuse research and development program is presented.

*Waste water treatment, *Industrial wastes, *Water reuse, Recycling, Research and development, Federal Water Pollution Control Act

Zero discharge, Environmental Protection Agency

856

J273
PUBLIC PARTICIPATION IN WATER POLLUTION CONTROL,

Ravan, F. E.

Environmental Protection Agency,
Atlanta, Georgia, Region IV.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 42-48.

A general discussion of the public's role in water pollution control is presented. Under the 1972 Federal Water Pollution Control Act, there must be citizen participation in hearings before the establishment of effluent limitations for industrial or municipal facilities. In addition, the EPA administrator, in cooperation with the States, is required to provide for public participation in the development, revision, and enforcement of any regulation, standards, effluent limitation, plan, or program developed by the Administrator or any State under the Act. Minimum guidelines are set for the participation. In a very few years State regulation of construction on flood plains, or unstable hillsides, in swamps, in wetlands, or on good cropland will probably be routine all over the country. Examples of the advances that citizen groups have made in cleaning up bodies of water, as well as examples of EPA sponsored pollution concern groups are discussed. It is expected that as the population becomes aware of the benefits of pollution control and abatement, strong remedial action will be supported.

*Water pollution control, *Pollution abatement, *Legislation, Federal Water Pollution Control Act, Local governments, Public rights, Environmental control, Standards

Public participation

J274
WASTEWATER RENOVATION AND REUSE: STATE OF THE ART,

Keinath, T. M.

Clemson University, Clemson, South Carolina,
Department of Environmental Systems Engineering.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 49-63. 3 tab, 8 ref.

The state-of-the-art of the renovation of municipal waste water for the reuse of such waters as a viable water resource is discussed. The four basic areas that this discussion covers are: the public's attitude toward the reuse of renovated municipal waste water; the specific health considerations; the primary reclamation processes; and, the experiences of a reclamation facility in renovating waste waters for reuse. A public attitude survey was sponsored by the University of California at Berkeley and the California State Department of Public Health to determine how the public would respond to the concept of reusing municipal waste waters. The consensus was that proposals to implement the reuse of renovated municipal waste waters would not meet with serious opposition as long as the proposals are properly introduced. The health aspects of reusing municipal waste water include bacteriology, virology, algology, parisitology, and toxicology. The treatment processes that are capable of the high degree of treatment required for reuse purposes are those that were developed under the supervision of the Advanced Waste Treatment Program of the Environmental Protection Agency. These treatment methods include coagulation, adsorption, filtration, ion exchange, nitrogen removal, and reverse osmosis/ultrafiltration. Operation of the South Lake Tahoe, California, reclamation facility is discussed.

*Waste water treatment, *Municipal wastes, *Water reuse, Public health, Treatment facilities, Coagulation, Adsorption, Filtration, Ion exchange, Nitrogen, Reverse osmosis, Reclaimed water, Reviews

J275
POLLUTION CONTROL OPTIONS OTHER THAN TREATMENT,

Sercu, C. L.

Dow Chemical Company, Midland, Michigan,
Environmental Control Systems.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 64-81. 15 fig.

The necessary planning that must be performed to ensure that the best solution to a waste treatment problem is chosen is discussed. Treatment of industrial wastes is not always the best way to solve the problem. Recovery, reuse, and reduction are alternatives to treatment. These three alternatives can be accomplished by such changes as process modifications, new processes, better housekeeping, and waste segregation. Cost/benefit analyses must be performed to help decide between terminal treatment and alternatives. The key to a successful program is to get commitment for pollution control from the top management. Top management must formulate the policy, goals, and assign the responsibility. Making environmental control a factor in the determination of raises and promotions will apply meaningful pressure on all personnel involved.

*Waste water treatment, *Industrial wastes, *Planning, Environmental control, Pollution abatement, Cost-benefit analysis

J276
WASTES RECYCLING BEFORE FINAL WASTE DISPOSAL,

Phillips, J. M.

General Electric Company,
Schenectady, New York, Environmental Protection Operation.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 82-86.

Alternatives to industrial waste water treatment are discussed. Alternatives such as waste recovery and incineration are means of reaching the 1985 zero discharge goal. Within the General Electric company, waste recovery is emphasized as a daily cost saving measure and standard operating procedure. Copper is reclaimed at a rate of $14 million dollars per year. A plant in Hendersonville, North Carolina, resmelts 200 tons of aluminum per month for internal use, and another plant in Louisville, Kentucky, converts 150,000 tons/year of steel punching into cast iron. Incineration is considered as one method of ultimate disposal, especially in situations where toxic chemicals must be disposed of. Incineration presents a trade-off situation between how much air pollution will be permitted vs. the contents of the scrubber water, and between the amount incinerated vs. the amount landfilled. When designing waste water treatment systems the following steps must be included: bring management into the picture including safety, water pollution, air pollution, noise pollution, and solid waste; and, consider alternatives to end-of-the-pipe treatment. Some case histories of alternatives to end-of-the-pipe treatment are presented.

*Waste water treatment, *Recycling, *Industrial wastes, Waste water disposal, Waste disposal, Incineration, Ultimate disposal, Planning, Water pollution, Air pollution, Solid wastes, Pollution abatement

Waste recovery, Waste recycling, Waste reclamation, Zero discharge

J277
ULTIMATE DISPOSAL BY MEANS OF DEEP WELL INJECTION: A LEGAL VIEW,

Cox, W. E., and Walker, W. R.

Virginia Polytechnic Institute,
Blacksburg, Virginia Water Resources Research Center.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 87-103. 49 ref.

The legal aspects of deep well injection for the ultimate disposal of liquid wastes are not well defined. There is no general agreement as to whether injection constitutes ultimate disposal or is actually just storage. Deep well injection can be considered as the final solution to certain liquid waste problems as long as a disposal stratum of low utility exists into which the waste can be injected without harmful effects, and the waste can be permanently confined to this stratum. The potential hazards of underground disposal emphasize the need for regulatory controls. It has traditionally been the responsibility of the states for injection well control. State legislation exists in the form of specific disposal well statutes, general pollution control laws, oil and gas laws, and well water statutes. The legislation covers the general subjects of preliminary exploration, well design and construction, operational controls, monitoring, and well abandonment. The regulations of the Colorado Board of Health are presented as a model of comprehensiveness. Legal disputes could arise from a variety of sources: well failure resulting in contamination of water supplies or damage to other natural resources; the migration of injected materials into the underlying space of adjacent landowners without the occurrence of measurable damage; and, injection-induced seismic activity. The case law that will be used to provide precedent for resolution of legal differences between private parties is very hazy.

*Ultimate disposal, *Liquid wastes, *Legislation, *Legal aspects, Underground waste disposal, Waste disposal wells, Waste water disposal, Injection wells

J278
ASSESSING PHYSICAL POTENTIAL FOR DEEP DISPOSAL OF INDUSTRIAL WASTES BY WELLS IN THE SOUTHEASTERN UNITED STATES,

Hackett, J. E., Hayman, J., and Lewis, S.

Virginia Polytechnic Institute and State University,
Blacksburg, Division of Environmental and Urban Systems.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 104-120. 4 fig, 2 tab, 10 ref.

A study was conducted of the physical potential for deep well disposal of wastes in the Mid and South Atlantic States. The basic steps in the general procedure for regional assessment include: the identification of geologic, hydrologic, and geochemical criteria for suitable disposal environments; the identification of the regional physical framework in terms of factors relevant to deep well disposal; and, assessing the characteristics of the regional framework in terms of stipulated criteria to determine the relative favorability of various environments with regard to deep disposal. A comprehensive review of the literature identified twenty environmental factors which determine the physical feasibility for deep well disposal. The geologic provinces and subprovinces which constitute the primary physical framework, and regional seismicity patterns which determine tectonic stability are discussed for the Mid and South Atlantic states. Assessment of the physical potential for deep disposal varies according to the type of waste. This study separated brines, liquid industrial wastes (subdivided into non-acid and acid), and radioactive wastes, including liquid radioactive and radioactive cement slurry. The crystalline Piedmont Province is unfavorable for injection disposal due to the lack of confinement conditions. The most favorable province is the Coastal Plain due to the lateral continuity of stratigraphic units and the opportunity for confinement of disposed wastes. Tectonic activity is a constraining factor in South Carolina.

*Ultimate disposal, *Liquid wastes, *Underground waste disposal, *Feasibility studies, Geologic investigations, Geographical regions, Geological surveys

859

J279
ULTIMATE DISPOSAL OF WASTEWATERS,

Greenfield, S. M.

Environmental Protection Agency, Washington, D. C.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 121-126.

The Environmental Protection Agency provides financial support for projects for the development of water reuse technology to help meet the goals of the 1972 Federal Water Pollution Control Act. EPA supports the continued development and implementation of waste water reclamation, reuse, recycling, and recharge. Emphasis is placed on the potential for waste water reuse in agricultural, industrial, municipal, recreational, and groundwater recharge applications. The direct interconnection of waste water reclamation plants with municipal water treatment plants, and projects including procedures for the rapid identification and removal of viruses and organics, epidemiological and toxicological analyses, advanced waste water drinking water treatment process design and operation, development of water quality requirements for various reuse opportunities, and cost-effectiveness studies are not currently supported by EPA. Eighteen major waste water reuse projects for a total investment of $5,400,000 have been supported by EPA. Among these projects are ones at Lake Tahoe, Santee, and Antelope Valley, California. Most of the EPA funded research in the fiscal year 1973 was concerned with land treatment systems for effluents and sludges. Well-known EPA financed projects in this area are groundwater recharge at Whittier Narrows, California, Pennsylvania State University's project, and the Muskegon, Michigan, spray irrigation project.

*Research and development, *Federal Water Pollution Control Act, Financing, Projects, Technology, Water reuse, Recharge, Irrigation, Reclaimed water

Environmental Protection Agency

J280
SLUDGE HANDLING AND DISPOSAL-STATE OF THE ART,

Dick, R. I.

Delaware University, Newark, Department of Civil Engineering.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 127-142. 1 fig, 27 ref.

A critical analysis of the state of the art of sludge handling and disposal is presented. In addition, the attitudes towards sludge treatment and disposal that have determined the nature of present practices are discussed. Sludge treatment and disposal account for 25 to 50% of the total cost of waste management; they are the largest single factor in the total cost of operating and maintaining waste water treatment facilities. Sludge treatment and disposal systems involve thickening, conditioning, dewatering, conversion, transportation, and ultimate disposal. A significant reduction in sludge handling costs can be achieved by effective thickening. Thickening is accomplished by gravity sedimentation, by dissolved air pressure flotation, and by centrifugation. Organic chemical coagulants, such as ferric chloride and lime, are the most common chemical conditioners, but the use of synthetic organic polyelectrolytes is increasing. Dewatering sludges makes them more amenable to solids handling procedures, reduces their volume, and increases their fuel value. Vacuum filtration and filter pressing are used for dewatering. Conversion includes anaerobic digestion, combustion, aerobic digestion, composting, disinfection, and pasteurization. Current attitudes towards sludge handling and disposal do not constitute the most rational approaches. A system of regional sludge handling facilities is suggested. Sludge handling needs to be incorporated into the total waste treatment scheme, not left as an afterthought, as it is currently left in many cases.

*Waste water treatment, *Sludge treatment, *Sludge disposal, Facilities, Costs, Dewatering, Ultimate disposal, Sedimentation, Centrifugation, Flotation, Coagulation, Polyelectrolytes

J281
SLUDGE RECYCLING: THE WINSTON-SALEM EXPERIENCE,

Styers, F. C.

City of Winston-Salem, North Carolina.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 143-152.

A brief description is presented of the composition of the Winston-Salem industrial community, its sewer use ordinance, and its waste water treatment facility as background to the Winston-Salem sludge recycling project. The sludge was originally air dried and then offered free-of-charge to local farmers. When it became apparent that the amount of sludge produced was greater than could be utilized locally, a dehydration plant was constructed. This plant dehydrated the air-dried sludge and made it available to the public either in bags or bulk. The product of this plant was officially named Grogonite. There was no problem with producing a saleable product from the city's sludge. However, many legal problems hampered the marketing of the Grogonite. Winston-Salem now has a contract with Orgonics, Incorporated of Rhode Island. Orgonics will blend the sludge with formaldehyde and urea and produce a product (Organiform-SS) which contains 16% nitrogen. Orgonics will then sell this product to chemical manufacturers who will use it in blending various fertilizers. The dehydration plant facility is being modified to produce the new product. For each ton of Organiform-SS that is sold, the city will receive $5.

*Sludge treatment, *Sludge disposal, *Recycling, Fertilizers, Dehydration, Industrial wastes, Sewers, Waste water treatment, Treatment facilities, Ultimate disposal

J282
CHEMICAL ENGINEERING AND THE ENVIRONMENT--A REVIEW,

Australian Chemical Engineering, Vol. 16, No. 6, p 3, 5, 6, June, 1975. 8 ref.

A review is presented of air purification, water treatment, effluent disposal and recycling, and sewage treatment, as they pertain to chemical engineering in Australia. An increased use of smoke emission monitoring systems and air pollution monitoring equipment has been noted. Water pollution control standards are outlined in the Clean Waters Act of 1970, which sets limits that should be achievable by filtration, separation, sedimentation, and chemical treatment methods. Oil contamination is discussed as a common form of water pollution; monitoring devices and methods of cleaning oil spills are detailed. Basic principles of industrial effluent treatment and associated types of equipment are outlined. Sewage treatment is generally accomplished by biological treatment. Most sewage treatment and disposal equipment is now supplied as a complete plant, and many sewage treatment facilities are automatic, employing Vee-notch, magnetic flow meters, venturi tubes, differential flow meters, various measurement equipment, and special pumps for transferring sludges and slurries. It was concluded that chemical engineering will play an important role in identifying and solving environmental problems in Australia and in maintaining environmental quality.

*Water quality control, *Environmental effects, *Sewage treatment, *Air pollution, *Chemical engineering, Recycling, Equipment, Flow meters, Industrial wastes, Oil spills, Legislation, Review

Australia

J283
FEDERAL ENVIRONMENTAL LAWS AND REGULATIONS,

Zarytkiewicz, E. D.

Fluor Engineers and Constructors, Incorporated,
Anaheim, California.

Chemical Engineering, Deskbook Issue, p 9, 11, 13, 15, 17, October 6, 1975. 5 tab.

A summary is presented of previous major environmental requirements, recently enacted regulations, and future legislation and their potential impacts. Since the National Environmental Policy Act (NEPA) of 1969 was passed, any federal agency must prepare an Environmental Impact Statement (EIS) prior to taking any action that affects the environment. Delays in construction due to the time and money required to draft an EIS have caused excessive costs, which the federal government has now acknowledged. The 1970 Clean Air Act has set up maximum ambient concentrations for CO, NO2, SO2, non-methane hydrocarbons, and particulate matter. The Federal Water Pollution Control Act of 1972 has probably had the greatest impact on all industries, particularly that of chemical processing, than any other environmental law. Regulations of import are: the National Pollutant Discharge Elimination System (NPDES); Effluent Guidelines and Standards; Pretreatment Standards; Oil and Hazardous Substances Rules; Ocean Dumping Rules; and Toxic-Pollutant Standards. Other legislation has required that facilities engaging in production, consumption, or distribution of oil prepare Spill Prevention, Control, and Countermeasure Plan. New laws also apply to the control of noise, solid wastes, and pesticides in the environment. Recent and future legislation includes the Safe Drinking Water Act and new rulings to be initiated on land use control.

*Waste water treatment, *Water quality control, *Water treatment, *Legislation, *Environmental effects, *Federal jurisdiction, Land use, Potable water, Chemical industry, Oil spills, Federal Water Pollution Control Act

Safe Drinking Water Act, Environmental Impact Statements (EIS)

J284
EPIDEMIOLOGY OF SALMONELLAE AND FERTILIZING OF GRASSLAND WITH SEWAGE SLUDGE (SALMONELLENEPIDEMIOLOGIE UND GRUENLANDDUENGUNG MIT KLAERSCHLAMM),

Hess, E., and Breer, C.

Zentralblatt fuer Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, I. Abteilung Originale Reihe B, Vol. 161, No. 1, p 54-60, 1975. 1 fig, 2 tab, 11 ref.

Research conducted identified Salmonellae in more than 90% of sewage sludge samples collected. The maximum number of organisms found was 10,000,000/liter. Neither aerobic stabilization nor anaerobic digestion significantly reduced the Salmonellae contamination. Salmonellae in sewage sludge applied to grasslands can survive up to 72 weeks. Therefore, fertilizing with non-disinfected sludge may lead to transmission from plant to animal. There is an increasing number of Salmonella carriers among herds of cattle demonstrating that transmission is occurring and is a growing danger. The disinfection of sludge to be used as fertilizer is now a necessity. The disinfecting effect of pasteurization and of gamma irradiation on sewage sludge was investigated. Proper pasteurization in 5 plants (70 C for 30 min) resulted in 98-100% of the tested sludge samples containing less than 10 Enterobacteriaceae per gram. Application of 300 krad resulted in 97.2% of the samples containing less than 10 Enterobacteriaceae per gram.

*Waste water treatment, *Sludge treatment, *Salmonella, Disinfection, Sludge disposal, Anaerobic digestion, Fertilization, Irradiation, Gamma rays

Pasteurization

J285
SOCIAL AND ECONOMIC DEVELOPMENT CRITERIA IN POTABLE WATER AND SEWERAGE SYSTEMS (CRITERIOS SOCIALES Y ECONOMICOS DE DESSARROLLO EN LOS SISTEMAS DE AGUA POTABLE Y ALCANTARILLADO),

Ahumada, M. B.

Recursos Hidraulicos, Vol. 4, No. 2, p 216-222, 1975. 2 tab.

Rates for potable water and sewerage systems in Mexico date from about two decades ago. However, the cost of living has risen dramatically in the past few years, causing increased operating costs. Thus, the water and sewage treatment systems do not have available income to cover their service costs nor to pay amortization of and interest on invested capital. There is little financing for necessary expansion or rehabilitation. The problem of restructuring present rates is discussed. Governmental policy emphasizes educating the user regarding the benefits received from adequate potable water and sewerage service. Community participation in the construction and maintenance of new facilities is strongly urged to insure higher standards of living in this country.

*Potable water, *Sewage, *Water quality control, *Water quality standards, *Water rates, Community development, Costs, Rural areas, Construction, Water costs, Operating costs, Treatment facilities

*Mexico

J286
TOOLING THE WATER WORKS INDUSTRY,

Cooper, F. C.

Stevens, Thompson and Runyun, Incorporated,
Portland, Oregon.

Public Works, Vol. 106, No. 11, p 72-73, November, 1975. 2 fig.

The available new technology for the water treatment industry was reviewed. Much of this technology has not yet been demonstrated in large-scale water treatment plants. The most common water treatment process--alum coagulation, settling, and chlorination--is not totally effective in removing toxic materials. Organic removal requires different techniques, varying with local conditions. Activated carbon treatment and ozonation are offered as alternatives for disinfection. To destroy pathogenic bacteria and viruses, it has been found that a single disinfectant or treatment process is not always sufficient. Overly polluted river sources often require pre-ozonation or superchlorination followed by dechlorination with activated carbon or sulfur dioxide. Inorganic contaminants must also be treated by special methods. Some toxic chemicals, such as lead, mercury, arsenic, cyanide, chromium and cadmium, may be removed by chemical polymerization and precipitation, with subsequent gravity settling and filtration. Heavy metals may be removed by ion exchange or softening processes. Iron and manganese, which cause turbidity, have been oxidized successfully with ozone. While the water industry has the basic tools to develop better technology, additional research is urged.

*Water treatment, *Water analysis, *Laboratory tests, Ozone, Viruses, Treatment facilities, Toxicity, Heavy metals, Iron, Turbidity, Research and development

J287
HAULING DIGESTED SLUDGE IN TANK CARS,

Kostolich, M. S.

General American Transportation Corporation,
Chicago, Illinois.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 178-185. 2 fig.

A system for removing sludge from municipalities for disposal at a remote site is explained. The system uses railroads and specially designed cars hooked into unit trains. The system is called the Waste Freighter. The basic vehicle is a GATX 20,000 gallon tank car with special fittings. Sludge can be loaded through the top of the tank through a quick-operating manway cover, or through a loading connection at the bottom of the tank. Sludge is unloaded through a 12 inch valve at the bottom of the tank which can be equipped with a movable chute to direct the sludge beyond the rail ties. The tank car can hold about 80 tons of sludge; overloading is prevented by a ball float device which automatically shuts off the flow at the desired level. Two loading systems have been designed (indoor and outdoor) which can adapt to any combination of sludge volume vs. desired loading times. The use of the Waste Freighter in a hypothetical city which produces a volume of sludge equivalent to about 4 million people is discussed. Using a 80 car unit train, a 200 mile trip to the application site (a strip mine to be reclaimed), and 7000 tons of wet sludge with 6% solids by weight, the cost to the city for this service would be less than two dollars per ton. The Waste Freighter eliminates capital investment in costly new sludge treatment facilities and a transportation system, conforms to present and future pollution standards, and can be easily expanded by increasing the number of tank cars.

*Sludge treatment, *Sludge disposal, *Ultimate disposal, Transportation, Railroads, Waste disposal, Costs

The Waste Freighter

J288
TRUMMER TUBE SCREW PUMP,

Effluent and Water Treatment Journal, Vol. 15, No. 9, p 491, September, 1975. 1 fig.

The Trummer tube screw pump was introduced in 1969 by the Trummer Company of Switzerland. The tube screw pump extends the range and application of screw pumps, reduces overall costs, and increases efficiency. The pump consists of an inner and outer tube with the screw flights contained in the space between the two tubes; the assembly is welded together and flange mounted to a bearing at either end. The pumping action is caused by rotation of the complete tube assembly. Novel design features have permitted the following advantages: no exposed rotating flights; elimination of the concrete trough; less smell and no splashing; increased efficiency at low speeds; no jamming at inlet to pump; and, no wear or loss of efficiency at tip of flights. A complete range of pumps is available with capacities up to 4000 liters/s and lifts up to 16 m at inclinations of 30 to 40 degrees.

*Pumps, *Pumping, *Equipment, Hydraulic equipment, Water conveyance, Hydraulic machinery

Screw pumps, Trummer tube screw pump

J289
WESSEX: EVOLVING WITH ITS DIVISIONS,

Freeman, L.

Water, No. 5, p 13-15, October, 1975. 3 fig.

A conversation with Kenneth Roberts, the chief executive of the Wessex Water Authority, is reported. The Wessex Water Authority differs slightly from the other nine WA's in its water company flavor, and its philosophy of evolution rather than revolution. Water company philosophy is reflected in the creation of the post of secretary to the authority, and the handling responsibility for recreation and fisheries as an on-line function of the chief executive. Fisheries is a growth sport and also has great public relations value. The post of secretary was envisaged as a sort of father figure in the water authority's administration. The post was developed because the Wessex authority is too small to need a director of administration. Rather than dictate the organizational structure, the Wessex Authority has consulted with the staff in the various divisions before forming multi-functional divisions. Since Wessex now consists of three fairly autonomous multi-functional units, the headquarters is now considered to have a planning role rather than a day-to-day role. Advisory committees have been established in each division made up of representatives of the local district councils, the CLA, the NFU, the CBI, and the Sports Council. The committees do not have executive roles, but long-term planning, medium-term planning, and problems are brought to the committees for their reaction before they are put to the authorities for decisions.

*Administration, Water works, Water treatment, Planning, Local governments

Water Authorities (Great Britain), Wessex Water Authority

J290
STREAMLINING HEAD-LOSS CALCULATIONS,

Larson, A. M., Jr.

Gilbert Associates, Reading, Pennsylvania.

Chemical Engineering, Vol. 82, No. 23, p 115-118, October 27, 1975. 3 fig, 4 tab.

A procedure is presented that can simplify the determination of head-loss of flowing fluids over a range of pipe sizes and temperatures. The method combines calculation and graphical construction to simplify the evaluation of fvv/2g and vv/2g. The method requires a minimum of detailed calculations and is very useful for performing parametric head-loss studies in liquid systems consisting of two or more pipe sizes and having varying liquid temperatures in different branches. An example is used to illustrate the method with step-by-step instructions.

*Pipes, *Piping systems (mechanical), *Head loss, *Pipeflow, Pipe lines, Reynolds number, Flow, Fluid mechanics, Flow rates, Temperature

J291
SEDIMENT TRANSPORT IN SMOOTH FIXED BED CHANNELS,

Novak, P., and Nalluri, C.

Newcastle University, Newcastle upon Tyne, England,
Department of Civil Engineering.

Journal of the Hydraulics Division-ASCE, Vol. 101, No. HY9, p 1139-1154, September, 1975. 10 fig, 17 ref, 2 append.

An analysis is presented of incipient motion and sediment transport as bed load in circular conduits and rectangular flumes with fixed smooth beds and free surface flow. The results and conclusions are directly applicable to engineering design, particularly sewer design. Experiments were conducted for incipient motion and bed-load transportation. The critical velocities obtained from these results are considerably lower than those normally used in sewer design. The study of incipient motion of isolated sediment particles resting on a fixed smooth channel bed resulted in equations for the critical velocity and critical shear stress. Channel shape produces a higher value of critical velocity or shear stress for a rectangular channel than a channel with circular cross section. The study of bed load transport resulted in a dimensionless expression for the channels of circular cross section. For the same value of flow parameters, a higher value of transport parameter is found in cases of fixed smooth bed channels.

*Sewers, *Sewerage, *Sediment transport, Sediment load, Mathematical models, Mathematical studies, Fluid mechanics, Sanitary engineering, Design criteria

J292
NITRATE NITROGEN DISTRIBUTION IN CORN LAND FOLLOWING APPLICATIONS OF DIGESTED SEWAGE SLUDGE,

Stewart, N. E., Beauchamp, E. G., Corke, C. T., and Webber, L. R.

Canadian Journal of Soil Science, Vol. 55, No. 3, p 287-294, August, 1975. 1 fig, 5 tab, 15 ref.

A study was conducted on the nitrogen distribution in crops and soil following applications of anaerobically digested sewage sludge. The following topics were discussed: some of the physical and chemical characteristics of digested sewage sludge; the influence of several sewage sludge application rates on nitrate accumulation and subsequent movement through the crop-rooting zone during a growing season; the evaluation of a crop as a method of soil nitrogen removal; and, an assessment of the nitrogen fertilizer value of digested sewage sludge with respect to crop yield. The digested sludge was applied to Harriston loam soil at rates of 0.0, 1.25, 2.5, and 5.0 cm/ha; corn was then grown on the plots. Nitrification of nitrate-nitrogen in the sludge occurred 6 days after application only in the top 20 cm of soil. The yields of corn grain and stover were significantly increased by sludge application rates greater than 1.25 cm/ha. The total-N concentration in the grain increased slightly at application rates above 1.25 cm/ha. About 3 to 12% of the total-N applied as sludge was removed by the corn. About 30% of the applied ammonium was lost one week after application due to volatilization. An annual sludge application on a Harriston loam on which corn is grown should not exceed 1.25 cm/ha.

*Sludge disposal, *Sludge, *Fertilization, *Nitrogen, Nitrates, Ammonia, Anaerobic digestion, Environmental effects, Agriculture

J293
THE CONTROL OF POLLUTION OF GROUNDWATER,

Henton, M. P.

Effluent and Water Treatment Journal, Vol. 15, No. 9, p 464-467, 473, September, 1975. 1 tab, 21 ref.

Groundwater pollution should be prevented for several reasons including: it is an increasingly valuable source of water; it is an integral part of the hydrosphere; it can reappear at the surface in the course of time; and, moving wastes from the surface to below ground is only storage and not a form of disposal or treatment. Contamination of groundwater from surface practices includes disposal of effluent to underground strata, leachate from refuse tips, agricultural practices, storage of oil, chemicals, and road salt, sewage or industrial settling basins, individual sewage disposal systems, and aquifer discharge. Aquifer overpumping and acid mine drainage are two examples of contamination resulting from the use of groundwater and rock. Contamination can be on a local or regional scale; each can be just as destructive and long-lasting as the other. The origin and nature of the rock, the structural geology, nature of any faults present, direction of movement of the groundwater, level and fluctuations of the water table, proximity of old mine workings, abstraction bore-holes or disposal points, and type and quantity of waste to be disposed of are all factors which must be considered in a situation concerning groundwater pollution. A hydrogeological report should be prepared with recommendations as to the suitability of any site for the particular purpose in mind. Legislative controls in England on groundwater pollution are discussed. The Control of Pollution Act, 1974, tries to include all forms of pollution and uses a new approach in controlling underground wastes.

*Waste water disposal, *Groundwater, Underground waste disposal, Water pollution, Legislation, Water pollution sources, Groundwater resources, Waste disposal wells, Waste water (pollution)

Groundwater pollution

J294
INDUSTRIAL AND MUNICIPAL SLUDGE DEWATERING-THE BOEING "BEST" SYSTEM,

Ames, R. K., Peters, H. H., and Olson, R. L.

Boeing Aerospace Company, Seattle, Washington,
Environmental Protection Systems.

In: Proceedings of the 29th Industrial Waste Conference, May 7-9, 1974, Lafayette, Indiana, Purdue University, p 207-212. 6 fig.

The Boeing Extractive Sludge Treatment (BEST) process is discussed. Emphasis in the study is placed on industrial sludge. This process uses the unique properties of a family of aliphatic amine solvents to remove water and oil from both organic and inorganic sludges. The products are a dry sludge, clear water effluent and oil that can be used as an energy source or a commercial byproduct. Other advantages included economical operation and lack of environmental impact. The unusual property of this class of solvents is a reverse solubility with temperature characteristic. When these solvents are added to a sludge, and the system is cooled, it becomes a two phase system, with solid particles dissolved in a solution of water, oil, fats and solvent. Solids are removed mechanically. A small temperature increase separates the water from the solvent, oil and fat solution, and the latter is separated by distillation. Theoretical cost comparison of this process with brute force drying of the water shows the BEST process is more economical. The process works well on both municipal and industrial sludges. The process used on a high lime sludge produced 27.2% filter cake and a clear sterile effluent. Used on an oily waste, there was left 35% dried solids and a colorless clear effluent. Further separation gave a water effluent containing 0.1% solvent and no oil. Most of the oil was recovered. The dry filter cake and the effluents were analyzed for their quality. The system was run and discharges analyzed over a period of time to determine optimum operational parameters and to refine system operation economics.

*Dewatering, *Municipal wastes, *Industrial wastes, *Sludge treatment, Waste water treatment, Sludge, Cost comparison, Effluents, Oil, Solubility, Lime

J295
THE CONSTRUCTION AND OPERATION OF GRAVEL WELL SOURCES WITH PARTICULAR REFERENCE TO THOSE OF THE NENE AND OUSE WATER BOARD,

Wilson, H. B.

Journal of the Institution of Water Engineers and Scientists, Vol. 29, No. 3, p 123-138, May, 1975. 4 fig, 2 tab, 7 ref.

As part of water resources management planning in Great Britain, the potential use of gravel well sources for water supply has been investigated. With an increasing water demand and the length of time and/or costs of cleaning up rivers, gravel wells may be a useful source for small water supplies. Problems connected with sites and well construction in the Nene and Ouse Water Board area were discussed. It was found that the yield of gravel well sources varies in Great Britain from 0.1 to 5.0 mgd depending upon the extent and depth of gravel deposits (which are dependent on the size of river flowing through them). The possibility of combining gravel and river water may be used to give a total required quantity. The quality of water obtained from gravel wells was generally good, with no taste or odor problems. Water quality deterioration may occur when sites are flooded; this may be overcome by a single stage of filtration. Also, abstraction can continue at times when other aquifers would be over pumped.

*Water supply, *Wells, *Water resources management, *Water treatment, Rivers, Construction costs, Odor, Water quality, Filtration, Aquifers, Groundwater

Gravel wells

J296
THE EFFECT OF INCINERATION ON METALS, PESTICIDES, AND POLYCHLORINATED BIPHENYLS IN SEWAGE SLUDGE,

Farrell, J. B., and Salotto, B. V.

National Environmental Research Center, EPA, Cincinnati, Ohio, Advanced Waste Treatment Laboratory, Ultimate Disposal Research Program.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 186-198. 2 fig, 5 tab, 6 ref.

A study was conducted by the Ultimate Disposal Research Program, Advanced Waste Treatment Laboratory, at the National Environmental Research Center, Cincinnati, Ohio, to establish the concentration of hazardous materials in sludge, and to determine the fate of these substances upon incineration. Sludge samples were obtained from sewage treatment plants where sludge was being incinerated in multiple-hearth incinerators and fluidized bed incinerators. The sludge, ash, and scrubber water were analyzed for metals, pesticides, and polychlorinated biphenyls (PCB's). There is a wide range of concentrations of pesticides and PCB's in sludge indicating that these compounds could be a minor problem in some cases and a major problem in others. There is no easy way to tell without testing whether a sludge contains a high level. Pesticides and PCB's were not found in the ash or scrubber water. It is infered that these are destroyed by incineration. The concentrations of hazardous metals are considerably higher in sludge than in soil or coal fly ash. The concentration seems to be related to the fraction of the waste which comes from industrial sources. Except for mercury, metals show no serious disproportionation into the particulate phase leaving the incinerator. Mercury is essentially totally vaporized into the stack gases. More investigation on the fate of pesticides, PCB's, and metals upon incineration is needed.

*Waste water treatment, *Municipal wastes, *Industrial wastes, Pesticides, Polychlorinated biphenyls, Heavy metals, Metals, Sludge, Incineration, Waste disposal, Mercury

J297
THE OCEANS AS ULTIMATE SINKS FOR WASTEWATERS AND WASTEWATER RESIDUALS,

Barber, R. T., and Kirby-Smith, W.

Duke University Marine Laboratory,
Beaufort, North Carolina,
Oceanographic Program.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 199-213. 3 fig, 1 tab, 23 ref.

The Ocean Dumping Law, H.R. 9727, prohibits dumping of radiological, chemical, or biological warfare agents or high level radioactive wastes, and provides for the strict regulation of any material which could adversely affect human health, welfare, the marine environment, ecological systems, or economic potentialities. The ecological response to certain kinds of intentional waste dumping are discussed, and a basis is provided for the value judgments required to determine if a given ecological response is an adverse effect. The deep ocean ecosystem is a high diversity system, containing a large number of species. High diversity systems are stable under a constant environment, but are fragile when faced with environmental variations. Thus, ocean disposal would adversely affect the deep ocean systems if the ocean dumping produced changes in the environment. Research has determined that microbial turnover rates in the deep ocean are very slow. Work performed with the submersible Alvin of the Woods Oceanographic Institution on microbial degradation in deep ocean systems is described. The low turnover rates indicate that organic rich waste would accumulate on the ocean bottom if dumped beyond the continental shelf. The organic overload from a short period of dumping could last for centuries or longer. There is evidence that the relatively rapid degradation of certain wastes by deep sea metazoans is adapted only to these specific food resources; organic wastes such as sewage sludge would have to be degraded by the microbial populations rather than by the metazoans.

*Waste water disposal, *Sludge disposal, *Oceans, *Environmental effects, Legislation, Ultimate disposal, Waste assimilative capacity

Ocean disposal, Benthic waters
J298
DETERMINING ULTIMATE CAPACITY OF THE COASTAL ZONE FOR WASTEWATER AND WASTEWATER RESIDUALS,

Carpenter, J. H.

Rosenstiel School of Marine and Atmospheric Science,
Miami, Florida,
Chemical Oceanography.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 216-224. 8 ref.

The following factors are important when considering the capacity of coastal waters for assimilating waste waters: conditions leading to possible transmission of bacterial, viral or parasitic human diseases; contamination of seafood with toxic chemical substances; and, changes in the physical and chemical characteristics of the waters and sediments which will cause changes in the abundance and diversity of marine life. Since the different areas of the coastal zone of the United States have different physical and biological systems, emission standards must be developed on a regional basis. A hypothetical situation is discussed: the disposal of a well digested, dispersible, and sterile sludge into the northeast coastal zone. The effects of disposal on transparency, nutrients, dissolved oxygen concentration, and heavy metals are discussed. Altered transparency, nutrient concentrations, and dissolved oxygen concentrations are identified as controlling factors to avoid degradation of shelf waters. A large dilution factor is a possible acceptable design criterion for these factors. However, the dilution factor is so large that to dispose of the total sludge production in the year 2000 would require the total renewal of shelf water for adequate dilution. Alternatives to ocean disposal include thickening and then burial in submarine landfills, incineration, and land disposal. These alternatives have their own limitations. Continued attention to limited ocean disposal will be necessary where no practical alternative can be developed.

*Waste water disposal, *Sludge disposal, *Oceans, Environmental effects, Waste assimilative capacity, Ultimate disposal, Continental shelf, Coasts

J299
HOW TO COMMUNICATE COMPLEX ISSUES TO THE PUBLIC,

Gill, K. D.

Environment Reporter,
Washington, D. C.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 226-228.

Lawyers, engineers, scientists, and government officials are among those professionals who have developed specialized languages of their own. Although most of the terms used within a discipline have specific meanings and convey a precise thought or concept to people within that discipline, these terms are often meaningless to others. Several practical suggestions are offered for communicating technical specialized thoughts to the public. The first point is to be aware that highly complex technical terms are being used when one discusses his specialty. The clearer the presentation, the better the chance of being understood. The second point is to make use of the press, whether reporters or public relations agencies. The ideal situation is to make available to the reporter a copy of the presentation.

*Communication, *Technical writing, Terminology, Technology, Social aspects, Management, Publications, Environmental engineering, Psychological aspects

Technical language, Technical presentations

J300
LAND DISPOSAL: STATE OF THE ART,

Reed, S. C.

U. S. Army Cold Regions Research and Engineering Laboratory,
Hanover, New Hampshire.

In: Ultimate Disposal of Wastewaters and Their Residuals, April 26-27, 1973, Raleigh, North Carolina, Research Triangle Universities, p 229-258. 1 tab, 42 ref, 1 append.

A multidisciplinary comprehensive technical assessment of the effectiveness and effects of land disposal of secondary treatment effluents has been performed. Spray irrigation is the controlled spraying of inches of liquid per week onto the land, with an infiltration and percolation flowpath within the boundaries of the site. Overland runoff is the controlled discharge of inches of liquid per week onto the land, with a downslope sheet flowpath. Rapid infiltration is the controlled discharge of feet of liquid per week onto the land; the flowpath is high rate infiltration and percolation. The quality of the product water from land disposal methods should be close to potable/irrigation water standards. Any of the application modes can meet the quality standards if proper site conditions exist and proper operational criteria are used. Spray irrigation is the most reliable method, followed by overland runoff and then rapid infiltration. Either primary or secondary effluents can be applied by spray irrigation or overland runoff methods and still achieve sufficient product quality. The land disposal site should not be treated as a neglected waste sink. The pretreatment steps and the site must be managed as a total system to produce optimum responses.

*Waste water disposal, *Irrigation, Waste water treatment, Sewage effluents, Environmental effects, Potable water, Water quality, Overland flow, Infiltration, Sprinkler irrigation

Spray irrigation, Rapid infiltration, Land application 870

J301
PUMPS: APPLICATION AND DESIGN BASICS, PART II,

Chermisinoff, N. P.

Clarkson College of Technology,
Potsdam, New York,
Department of Chemical Engineering.

Water and Sewage Works, Vol. 122, No. 10, p 66-67, October, 1975. 1 fig, 2 tab.

Reciprocating pumps are positive-displacement pumps in which the piston movement discharges a specific volume of liquid during each stroke. Direct acting pumps can be simplex units comprising one steam and one liquid piston, or duplex units comprising two steam and two liquid pistons. They have a pulsating discharge. Power pumps involve a crankshaft that is driven from an external electric motor with gears usually located between the drive and crankshaft. Diaphragm pumps are used for large flows of clean or solid-containing fluids. Rotary plunger pumps are single-acting pumps with five to seven plungers positioned in a circle. The following terms are defined to aid in the understanding of various pump design parameters: head, static head, static suction head, static discharge head, total static head, friction head, suction head, discharge head, total head, net positive suction head, static suction lift, suction lift, absolute pressure, barometric pressure, gauge pressure, vacuum, vapor pressure, entrance losses, exit losses, and line losses.

*Pumps, *Pumping, Hydraulics, Hydraulic engineering, Equipment, Hydraulic equipment, Hydraulic machinery, Water conveyance, Design criteria

J302
GEOCHEMICAL FACTORS AFFECTING ARTIFICIAL GROUNDWATER RECHARGE IN THE UNSATURATED ZONE,

Wood, W. W., and Signor, D. C.

U. S. Geological Survey, Lubbock, Texas.

Transactions of the ASAE, Vol. 18, No. 4, p 677-683, July/August, 1975. 11 fig, 1 tab, 14 ref.

Recent research on artificial groundwater recharge has focused on spatial-temporal aspects. The type and magnitude of chemical controls at a site are studied. Chemical considerations are placed into two categories: the change in geometry of the interstitial pore space and the prediction of the quality of the water with time. The observations discussed fall into the second category. The recharge facility used, a 0.4-ha basin near Lubbock, Texas, is typical of the Southern High Plains of Texas and New Mexico, and the water was imported from Lake Meredith, near Amarillo. Porous ceramic cups were used to collect water samples at depths of 0.6, 2, 8, 16, 23, and 33 meters, first daily and then weekly. Chemical analyses were performed for pH, bicarbonate and specific conductance. Chloride concentration increased with depth. Ion exchange was one of the most important chemical processes observed in the system. Cation and anion exchange took place, but cation exchange dominated. This could be an important consideration in a predictive model, depending on whether or not the water is intended for human consumption. Some sulfate adsorption takes place and the effects are still being studied. Desorption of silica was the other major mechanism that affected the water quality. Sulfate reduction signaled a hydrologic change but the effect was small because of the rapid loss of hydraulic conductivity. Some mineral solution occurred but also had a very small effect. Studies should be conducted at other sites on the Southern High Plains of Texas and New Mexico, including more detailed analyses. With enough pertinent data incorporated into a model, accurate predictions can be made on water quality changes.

*Geochemistry, *Artificial recharge, *Groundwater, Chemcontrol, Chemical analysis, Recharge, Texas, New Mexico, Ion exchange, Anion exchange, Cation exchange

J303
REVEGETATING BITUMINOUS STRIP-MINE SPOILS WITH MUNICIPAL WASTEWATER,

Edgerton, B. R., Sopper, W. E., and Kardos, L. T.

Pennsylvania State University,
University Park,
Department of Forest Hydrology.

Compost Science, Vol. 16, No. 4, p 20-25, August, 1975. 5 tab, 9 ref.

The problem of revegetating acres of land which had been strip mined was investigated. This portion of the research dealt with the determination of the effects of irrigation with municipal sewage effluent and liquid digested sludge on the germination, survival and growth of a variety of grasses on a strongly acid and highly toxic spoil material. Six lysimeters were filled with strip-mine spoil material; the spoil was seeded with 8 grasses and 8 legumes and treated with effluents at various treatment rates. It was found that applications of municipal sewage effluent and liquid digested sludge did facilitate the establishment and growth of selected grass and legume species on this material. There was no vegetation toxicity problem from the heavy metal concentrations in the effluents or sludge. The grass species had higher yields and greater percent areal cover than the legume species. The best vegetation growth and establishment was found with the application of 2-inches of sludge plus 2-inches of effluent. Overall, the grasses with the greatest dry matter production had the lowest concentrations of toxic metals in the above-ground plant tissues. On the other hand, the legumes with the best yields had some of the highest metal concentrations in their foliage. Results of this research suggest that treated municipal sewage effluent and liquid digested sludge are a valuable resource and can be used to neutralize the site conditions found on strip-mine spoil banks, thus facilitating vegetation.

*Land use, *Waste disposal, *Sewage treatment effluents, *Sewage disposal, Sludge disposal, Mining, Irrigation, Grasses, Legumes, Strip mines, Heavy metals

Land application, Strip-mine spoil banks

J304
POLYMER CONDITIONING OF CHEMICAL SLUDGES,

Novak, J. T., and O'Brien, J. H.

Missouri University, Columbia,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 10, p 2397-2410, October, 1975. 19 fig, 1 tab, 15 ref.

Chemical sludge conditioning is used to alter sludge characteristics so that dewatering process yields can be improved. An evaluation of the influence of polymers and sludge characteristics on polymer selection and dose requirements for conditioning was performed. The sludge characteristics studied included type of sludge (alum, lime, or iron), pH, percentage of solids, specific resistance, filter cake solids, and compressibility. The polyelectrolytes tested varied in the molecular weight, charge, charge distribution, and chemistry of the polymer. Sludge dewatering is improved by the use of high-molecular weight organic polymers which decrease the sludge specific resistance. High-molecular weight organic polymers also increase the sludge compressibility but have negligible effect on filter cake solids concentration. A linear relationship exists between optimal polymer dose and sludge solids concentration. Sludge pH and filter cake solids concentration variations cause differences in dose requirements. The dose requirements have an inverse relationship with polymer molecular weights. Polymers with molecular weights less than 0.000001 are ineffective for chemical sludge conditioning. Selection of polymer also depends on pH. Nonionic to moderate-activity anionic polymers function well between pH 6 and 8.5, while high-activity anionic polymers function well at pH greater than 8.5. Neutral or slightly acidic conditions are best for cationic polymer functioning.

*Sludge treatment, *Dewatering, *Polymers, *Polyelectrolytes, Waste water treatment, Water treatment

Conditioning, Chemical sludges

J305
RESEARCH NEEDS RELLVANT TO ENVIRONMENTAL DATA,

Willis, B. H.

Environmental Research and Technology, Incorporated,
Concord, Massachusetts,
Environmental Studies Division.

Journal of the Hydraulics Division, ASCE, Vol. 101, No. HY11, p 1423-1432, November, 1975, 4 fig, 1 ref. 1 app.

Problems associated with the adequacy of environmental data, primarily as currently incorporated in environmental impact assessment reports, are analyzed. The context in which environmental data are used must be considered. Data can be used for academic and scientific research purposes, environmental impact assessment purposes, or resource planning purposes. In all three cases the data requirements are different. Often, however, the distinctions are not made. Two basic data acquisition requirements are necessary: the establishment of an initial preproject data base; and the monitoring of actual impacts during the operation of the project. Data requirements necessary to establish intermedia relationships must be established. The development and application of new techniques for collecting environmental data are also necessary. Remote sensing techniques can be applied, especially after the recent developments in military reconnaissance and the space program. Regional data monitoring networks should also be implemented. Major elements of such systems are now in operation. Perhaps the most critical research need is to coordinate current data collection efforts to make data readily accessable to users. Data collection activities should be coordinated. There should be an efficient means for updating environmental data. Data appropriate to indicate cumulative environmental impacts of projects on a regional scale should be identified. This brings up the question of level of detail for the analysis of site-specific impacts. It is concluded that, due to a lack of a coordinated environmental data base, environmental impact statement efforts are inefficient.

*Environmental control, Data collections, Research priorities, Environmental effects

*Environmental data, *Research needs, Data requirements, Environmental impact statement

J306
WATER RESOURCES IN NORTHUMBRIA WITH PARTICULAR REFERENCE TO THE KIEDLER WATER SCHEME,

Burston, U. T., and Coats, D. J.

Northumbrian Water Authority, England,
Northumberland and Tyne Division.

Journal of the Institute of Water Engineers and Scientists, Vol. 29, No. 5, p 226-241, July, 1975. 3 fig, 5 tab, 8 ref.

The steps taken by the Northumbrian River Authority before the Northumbrian Water Authority took over to meet the future demands for water in the area are studied. The Kiedler Water Scheme is emphasized. The area described consists of about 3,580 sq miles, with a large population and the need for new industries. The average annual rainfall varies from about 25 inches in some areas to 90 inches in others. Industry and population tend to concentrate near the coast; therefore the possibility of the reuse of water is minimized. When the River Authority came into existence eleven water undertakings had their area of supply within the Authority area. New estimates of demand that the Authority made upon taking over had to consider industry, public water supply, and direct abstractors, such as agriculturists and industrialists who take the water out of watercourses that pass their land. Sources of supply to meet these demands that were considered included aquifiers, desalination, estuarial barrages and surface water. It was found that surface water in the form of reservoirs would be necessary to meet the demand. Different plans were considered and the one settled on was called the Kielder Scheme. The construction period would be five years, only one reservoir would be needed and the amount of flooding would cover half the area that the other plans would. This plan had the least cost, the most flexibility, and the most environmental and social soundness. The recreational potential was evaluated and plans included camping sites, fishing, hiking, picnicking and sailing.

*Water resources, *Water resources development, Aquifiers, Water demand, Reservoir sites, Water supply, Surface waters, Estuaries, Desalination, Recreation, Camping

J307
STUDIES ON PREVENTION OF WATER POLLUTION. IV. EFFECT OF SYNTHETIC DETERGENTS ON WASTE PURIFICATION WITH ACTIVATED SLUDGE PROCESS (Suishitsu odaku bosai ni kansuru kenkyu (Dai Po). Haisui no kasseiodei shori ni okeru gosei senzai no eikyo ni tsuite),

Sakaguchi, O., Yokota, Y., and Takashita, S.

Eisei Kagaku, Vol. 21, No. 4, p 194-198, 1975. 5 tab, 19 ref.

The effects of synthetic or commercial detergents on the efficacy of the activated sludge process was studied. Difficulties were observed in purifying sewage containing linear alkylbenzene sulfonate (LAS), which remained in the alkaline range (pH 8.2). While 10 ppm of LAS did not affect the purification of sewage by activated sludge, the addition of over 50 ppm LAS inhibited removal rates of both proteins and the detergent. The biodegradation of LAS was found to be inhibited by nutrients added in the sewage, but higher fatty acid sulfate showed a high degree of detergent removal from the sewage. In the case of commercial synthetic detergents, about 90% were degraded. For these, the presence of nutrients increased the amount of residual detergent in the supernatant after aeration. It was also seen that TTC reduction of substrates with activated sludge was slightly inhibited by the addition of LAS in the reaction medium.

*Detergents, *Sewage treatment, *Activated sludge, *Alkylbenzene sulfonate, Linear alkylate sulfonates, Water pollution, Biodegradation, Aeration

J308
FATE OF WASTEWATER SLUDGE IN THE NEW YORK BIGHT APEX,

Duedall, I. W., O'Connors, H. B., and Irwin, B.

State University of New York,
Stony Brook,
Marine Sciences Research Center.

Journal Water Pollution Control Federation, Vol. 47, No. 11, p 2702-2706, November, 1975. 1 fig, 1 tab, 21 ref.

The impact of dumped sludge in the New York Bight apex is being investigated. The present study reports some values for the total organic carbon (TOC), organic nitrogen, total carbohydrate, and caloric content of dried sludge. It also examined the fate of ocean-dumped sludges on the basis of sludge analyses, some preliminary carbon and nitrogen analyses of sediment from the apex, and recently reported in situ oxygen utilization observations in sediments underlying a sludge disposal area. In-plant waste water sludges were centrifuged to remove the water. The centrifugates were freeze-dried to obtain dry, uncrusted samples. The final sample treatment consisted of homogenizing the freeze-dried samples in a blender. The analysis of dried waste water sludge is presented in a table. When studying the fate of dumped sludge, it is important to note the diffusion of sludge immediately after it has been dumped, the rate of decomposition by pelagic and benthic microorganisms, the rate of sedimentation, and the subsequent sediment accumulation. Results indicated that the majority of particulate organic matter in waste water sludge settles near the dump site and quickly decomposes. This explains why unusually high TOC concentrations were not found in the sediments at or near the dump site. Cutin, a major sludge component, as well as other organic components, can be metabolized by decomposer microorganisms. The carbon to nitrogen ratios of sediments in the dump area were low; this indicated that nitrogen was not limiting.

*Sludge disposal, *Waste disposal, *New York, Microorganisms, Pollutant identification, Water pollution sources, Organic compounds, Centrifugation, Sedimentation

J309
BURN THAT SLUDGE!,

Loran, B. I.

The Ralph M. Parsons, Company,
Pasadena, California,
Systems Division.

Water and Wastes Engineering, Vol. 12, No. 10, p 65-68, October, 1975. 8 fig, 2 tab.

Restrictions on ocean disposal and loss of landfill space for the disposal of municipal refuse and sewage sludge as well as the energy crisis have caused municipalities to consider incineration as a disposal and energy conserving method. Representative chemical analyses and heat contents of refuse and sewage sludge samples are given. The energy contained in refuse can be recovered after shredding and air classifying by feeding the combustible materials into a coal-burning power plant as supplementary fuel or by pyrolizing the refuse to produce low-Btu fuel gas. The extreme dilution of aqueous suspensions of sewage sludge causes the energy content to be less readily available. Total recovery of the energy requires a number of dewatering steps; the recoverable heat usually does not balance the energy necessary for dewatering. Combined refuse/sludge combustion has been practiced. Refuse in the combined treatment supplies the heat necessary to evaporate the water so that combustion of the sewage sludge is self-sustaining. Refuse must be processed (shredded and separated into combustible and noncombustible products) before being used as a supplementary fuel or incinerated with sludge. A multiple hearth furnace is recommended for the disposal of mixtures of refuse and high solids sludge. If there is only a moderate amount of refuse available for combined incineration, then a fluidized bed furnace should be employed. Several commercially available pyrolysis units are discussed. A decision flowchart for choosing the correct disposal method is presented.

*Sludge treatment, *Sludge disposal, *Incineration, *Solid wastes, Energy, Waste disposal, Ultimate disposal, Burning

Pyrolysis, Combined refuse/sludge incineration, Domestic refuse

J310
ANAEROBIC DIGESTION OF SLUDGE, PART I,

Weland, A. F., and Cheremisinoff, P. N.

Malcom Pirnie Incorporated, Paramus, New Jersey.

Water and Sewage Works, Vol. 122, No. 10, p 80-83, October, 1975. 5 fig.

Anaerobic digestion of sludge was discussed. It is impractical to use digestors which double the capital cost and lower the Btu value of sludge if incineration is to be the ultimate disposal method. However, digestion will continue to be used in small treatment plants and in large cities where land and ocean dumping are available and economical. One of the major assets involved in using digestion is that it takes raw sludge containing noxious materials and produces a basically inert and useful landfill material. Other advantages of digestion are methane production, high organic loading, no oxygen transfer-aerators, reduction of volatiles, no additional nutrients, and low solids production. Disadvantages, aside from maintenance costs, include supernatant treatment, operation difficulties, erratic sludge volume reduction, close process control, need for backup systems, build up of fines in treatment plant, critical growth system, toxic oxygen, need for external heating, expensive tankage and dewatering. Anaerobic digestion consists of two stages. During the first stage, simple organic structures are formed through complex reactions involving anaerobic acid forming bacteria which metabolize solid and dissolved complex matter such as proteins, carbohydrates, fats, and other organic materials. The structures are metabolized through a number of intermediates to produce simple volatile organic acids and important buffering materials. During the second stage, simple volatile acids are metabolized by methane producing bacteria; methane and carbon dioxide are the main end products.

*Sludge treatment, *Anaerobic digestion, Anaerobic conditions, Sludge disposal, Waste water treatment, Landfill, Methane

J311
ENVIRONMENTAL EFFECTS OF ADVANCED WASTEWATER TREATMENT AT SOUTH LAKE TAHOE,

Antonucci, D. C., and Schaumburg, F. D.

California Regional Water Quality Control Board,
South Lake Tahoe,
Lahontan Region.

Journal Water Pollution Control Federation, Vol. 47, No. 11, p 2694-2701, November, 1975. 2 fig, 5 tab, 7 ref.

The results of an assessment of direct and indirect energy requirements and environmental impacts associated with the operation of the full-scale advanced waste water treatment plant at South Lake Tahoe, California, are reviewed. Although the installation effectively removes organic materials and nutrients from domestic waste water, it requires large amounts of energy and treatment chemicals. A number of contaminants are released on land and in the air. It is impossible to tell, despite quantitative data on energy and materials consumption and on contaminant emissions, if advanced waste treatment processes significantly reduce the net level of degradation in the total environment. A common denominator should be found with which different types and quantities of pollutants released in the environment could be quantitatively compared.

*Waste water treatment, *Treatment facilities, *Tertiary treatment, *Environmental effects, Energy, Pollution abatement

Secondary pollution

J312
LAND DISPOSAL SITE EXPANDS INTO LIQUID WASTE CONTROL,

Waste Age, Vol. 6, No. 9, p 46-47, 49-50, September, 1975. 9 photos.

The 226-acre CID (Calumet Industrial Development) Sanitary Landfill is the largest of the 29 sanitary landfills serving the six-county metropolitan Chicago area. The site accepts municipal, commercial, industrial, and demolition wastes. The site is located on an expressway system which links Chicago, the far southern suburbs, and northwestern Indiana, near the Little Calumet River which allows long distance barge transfer of wastes from the Great Lakes, and is served by a rail siding permiting railhaul/land reclamation systems. CID originated as a private corporation in 1964, and merged into Waste Management, Incorporated in 1971 and 1972. Its permit from the State of Illinois Environmental Protection Agency allows the disposal of putrescible and nonputrescible solids, and liquid wastes. Water base sludges and other flow flash industrial wastes are disposed of on the landfill without further treatment. Biodegradable materials are neutralized in filtration beds, while pickling liquids and chromic acids are treated in the neutralization tower with lime. This treatment creates an inert sludge which is used as interim cover in the landfill. A fleet of five tractors and 19 specialized tanker trailers, such as vacuum tankers, stainless tankers, rubber lined tankers and bulk liquid tankers are operated by CID. The site is located in a 90-ft deep vein of highly impervious clay soil which is ideal for waste containment and cover. Three shifts work on two faces of the site. While one face is getting its daily cover, the other site is receiving wastes.

*Waste water disposal, *Waste disposal, *Solid wastes, *Landfills, Ultimate disposal, Municipal wastes, Industrial wastes

J313
PVC PIPE IN WATER DISTRIBUTION: RELIABILITY AND DURABILITY,

Nesbeitt, W. D.

Petrochemicals Company, Incorporated,
Fort Worth, Texas.

American Water Works Association Journal, Vol. 67, No. 10, p 576-581, October, 1975.
7 fig, 1 tab, 14 ref.

The benefits and limitations of polyvinyl chloride (PVC) pipes for water utilities are outlined. The properties of PVC pipe that provide reliability and durability in water distribution systems are outlined. Cost benefits, such as flow capacity, strength-to-weight ratio, ease of handling, and joining technology are discussed. Because PVC is nonbiodegradable, it is not susceptible to the attack of bacteria or other microorganisms. However, PVC should not be exposed to heavy solvents and aromatics, and it may be affected by exposure to ultraviolet rays. PVC has the advantage of dielectric strength; it will not convey electric current and is not susceptible to electrolytic corrosion (as is metal piping). PVC pipe is flexible, giving it an advantage when it must be laid through unstable or heaving soils. PVC is a thermoplastic material, and allowances must be made in design and installation for expansion and contraction if pipeline will provide service over a wide range of temperatures. Safety factors for PVC and for traditional piping materials were compared. While plastic pipe can withstand short-term pressure surges, stresses and pressure ratings must be figured into pipeline design. Stress regression (SR) curves are presented and detailed. PVC, however, if subjected to a long-term history of cyclic pressure surges, may display failure, similar to that displayed in traditional piping materials. It was suggested that municipal water distribution systems should carefully consider the benefits as well as limitations in evaluating the use of polyvinyl chloride material for pipelines.

*Pipelines, *Plastics, *Pipes, *Water distribution (applied), Construction materials, Water treatment, Water supply, Costs, Regression analysis, Joints (connections)

*Polyvinyl chloride (PVC)

J314
NEERI ACCEPTS CHALLENGE TO REDUCE POLLUTION,

Indian Chemical Journal, Vol. 10, No. 1, p 13, July, 1975.

The National Environmental Engineering Research Institute (NEERI), Nagpur, India, has devised methods of treating industrial wastes and sewage which are inexpensive and unconventional but effective. The methods reduce capital costs up to 80% and reduce operating costs up to 90%. The methods take advantage of the sunshine and warm climate of India which favor the treatment of wastes in oxidation or stabilization ponds. Wastes are stored in large well-defined shallow ponds for several days while algae and bacteria digest the organic wastes. The waste water is then suitable for irrigation. Oxidation ditches with extended mechanical aeration are recommended for mid-sized towns because they require less surface area than oxidation ponds. Sewage treatment for these towns can pay for itself by providing irrigation water that contains all the essential nutrients (nitrogen, phosphorus, and potassium) for use as fertilizer. The reuse of sewage effluent for industrial purposes is also being instigated in large cities such as Bombay. The Central Board was created under the Prevention and Control of Pollution Act which was enacted in 1974. This board will promote the cleanliness of streams and wells and provide technical assistance and guidance to State Boards and sponsor investigations and research relating to problems of water pollution. Legislation is being studied which will tax the major industrial contributors to water pollution.

*Water pollution control, *Foreign research, *Waste water treatment, Sewage treatment, Industrial wastes, Oxidation lagoons, Aeration, Fertilizers, Irrigation, Legislation

Oxidation ditches, India, National Environmental Engineering Research Institute (NEERI)

J315
ORGANICS IN DRINKING WATER, PART I-LISTING OF IDENTIFIED CHEMICALS,

Junk, G. A., and Stanley, S. E.

Iowa State University, Ames,
Ames Laboratory, USERDA.

NTIS Report No. IS-3671, July, 1975. 84 p, 1 tab, 94 ref, 1 append.

A tabulation of the organic chemicals which have been identified in potable water and in other water which might be used as raw water sources for public drinking water is presented. The compilation was prepared by reviewing all available reports of organics in water. The table is an alphabetical listing of 423 organic chemicals of which 325 have been reported in drinking waters, and 394 have been specifically identified. Molecular weights, empirical formulas, structural information and literature citations are also given. The identified organic contaminants in drinking water are usually present at less than 10 micrograms/liter (10 ppB). Most of the identified organic chemicals with boiling points above 150 C are present in drinking water at concentrations less than one microgram/liter (one ppB).

*Potable water, *Organic compounds, *Pollutant identification, Water supply, Public health, Water analysis, Reviews, Water sources

J316
A GUIDE TO THE INTERSTATE CARRIER WATER SUPPLY CERTIFICATION PROGRAM,

EPA-520/9-74-024, June, 1975. 16 p, 1 fig, 1 tab.

The certification of water supplies for interstate carrier use is the responsibility of the Environmental Protection Agency, Regional Water Supply Division (ROW). Three safe-for-use certifications are necessary before water can be used on an interstate carrier: the watering point must be certified; the water supply must be certified; and, the bacteriological laboratory must be certified. This guide sets forth the criteria and procedures to be followed when classifying interstate carrier water supplies. It is an aid to the interpretation of the Drinking Water Standards designed to be used by persons responsible for ensuring potable water for interstate travelers. Bases for classification, a classification list, classification definitions, and classification criteria are discussed as well as water supply surveys and use prohibited notifications. Excerpts from the Public Health Services Drinking Water Standards are presented.

*Water supply, *Potable water, *Standards, *Water quality control, Legislation, Interstate

Interstate carrier water supply certification

J317
AUDIOVISUAL INSTRUCTIONAL UNITS FOR WATER POLLUTION CONTROL TRAINING PROGRAMS,

Donahue, A. E.

Environmental Protection Agency,
Cincinnati, Ohio.

NTIS Report, November, 1974. 34 p. PB 237 456.

Audiovisual instructional units currently used for training personnel in water pollution control are catalogued in this document. These units were developed to be used with an instructor as training support and are not self-contained teaching devices. Titles and details on the subject matter of each tape/slide set are provided; subject areas include activated sludge processes, anaerobic digestion, various chemical procedures, chlorine treatment plants, safety in waste water works, basic statistics, and details on how to produce tape/slide presentations. Included in this catalogue is information on how to purchase or borrow the various instructional units.

*Training, *Personnel, *Water pollution control, Activated sludge, Waste water treatment, Water treatment, Treatment facilities

*Audiovisual instruction

J318
MANUAL OF INDIVIDUAL WATER SUPPLY SYSTEMS,

1974. 155 p, 28 fig, 8 tab, 40 ref, 4 append. U.S. EPA Office of Water Programs.

This manual is a revision of a 1962 publication and is concerned with the needs of individuals or institutions who must choose alternative water supplies. Information has been published for use by Federal agencies, State and local health departments, well drillers, contractors and individual homeowners. Recommended practices as defenses against contamination must be practical; costs must be consistent with benefits; and changes must make an important contribution to the useful life of the installation. This manual is divided into five sections: selection of a water source; groundwater; surface water for rural use; water treatment; and pumping, distribution, and storage. Appendices are also included which provide information on a recommended procedure for cement grouting of wells for sanitary protection, sampling for bacteriological quality, and for emergency disinfection. A suggestion for drafting a local ordinance to permit legal controls over nonpublic groundwater supply systems used for domestic purposes has also been prepared.

*Water supply, *Legislation, *Water quality standards, *Groundwater, Wells, Surface waters, Rural areas, Water treatment, Pumps, Construction materials, Hydrologic aspects, Water pollution control

J319
FEASIBILITY OF HYDRAULIC TRANSPORT OF GROUND HOUSEHOLD REFUSE THROUGH SEWER APPURTENANCES,

Monaghan, D. A., and Guzdar, A. R.

Foster-Miller Associates, Incorporated,
Waltham, Massachusetts.

April, 1974. 138 p, 15 fig, 14 tab, 4 ref. EPA-670/2-74-021.

The feasibility of hydraulic transport of ground refuse in conventionally designed sanitary sewers was investigated. Experiments were conducted on the gravity flow of ground household refuse through inverted siphons, running traps, bends, manholes, pump well inlets, lift stations, and obstacles. Evaluations were presented on: the minimum flow rate at which refuse slurry can be satisfactorily transported through the pipe system; the rates, types, and classes of materials deposited in the pipe system and its appurtenances; and design modifications needed to minimize deposition of material or other conditions leading to unsatisfactory flow. Results of laboratory investigations with an experimental test loop showed that the hydraulic transport of ground refuse at concentrations of up to 1.0% is feasible. However, at a refuse concentration of 1.5%, significant increases in pressure drop were noted. It was concluded that for flow velocities of 2.5 feet per second and above, any head losses become negligible. It was also found at steady state that heavy solids accumulate at specific locations with small increases of head loss but no danger of blockage. Periodic cleaning of the pipes was recommended to minimize the need for excessive scouring.

*Sewers, *Wastes, *Waste disposal, *Solid wastes, Pipes, Hydraulics, Flow rates, Equipment, Cleaning

Ground household refuse, Hydraulic transport

J320
WATER POLLUTION SURVEY, MOODY AIR FORCE BASE, GEORGIA,

Virost, R. A.

Environmental Health Laboratory,
Kelly Air Force Base, Texas.

November, 1974. 121 p, 5 fig, 29 tab, 3 ref, 8 append. ADA-003212.

An analysis has been made of the Moody AFB, Georgia, sewage treatment plant operating logs for the period January to November 1973. On-site investigations were also conducted of the sewage treatment system, storm drainage system, and plant operators' laboratory procedures. The treatment facility was designed for 0.75 mgd and is a well-run low-rate trickling filter plant. Secondary treatment is provided to 0.393 mgd of average strength sewage. While the base has received its final NPDES permit, the plant will require modifications to meet water quality limits as of July 1, 1977. It was recommended that a stream dissolved oxygen survey be used to gather data on the effect of waste discharge on receiving waters. A sampling protocol was included to supplement sewage treatment plant monitoring requirements. Sources of industrial waste discharge to the storm sewer system were identified, and current planning includes oil-water separators and pipes to connect these streams to the sanitary system.

*Sewage treatment, *Treatment facilities, *Water analysis, Waste disposal, Filters, Water quality control, Waste water treatment, Separation techniques, Industrial wastes, On-site investigations, Water quality

J321
A PILOT STUDY OF DRINKING WATER SYSTEMS AT BUREAU OF RECLAMATION DEVELOPMENTS,

June, 1973. 5 fig, 11 tab, 2 append. EPA-430-9-73-004.

A pilot survey of 58 drinking water supply systems at 26 Bureau of Reclamation reservoirs assessed the water quality, construction, maintenance, operation, and surveillance of these systems. Field work was completed in October and November of 1971 and was divided between flood control and irrigation reservoirs in Kansas and California, and along the Colorado River. Bacteriological samples were collected of the distribution-system water, of the raw water, and at all hand-pumped wells. Complete chemical and physical analyses were made, and chlorine residuals were measured at each sampling point. In addition, the distribution system pressure was determined. Findings of the study indicated that 33 (57%) of the systems delivered water that failed to meet at least one constituent limit of the Drinking Water Standards. Fourteen systems (24%) did not meet at least one mandatory chemical or bacteriological limit and seven of the systems (12%) were contaminated with coliform bacteria. Only four (7%) of the systems practiced a bacteriological surveillance program that met the Public Health Service Drinking Water Standards criteria. To improve the water quality it was recommended that State and county governmental agencies should initiate and maintain an acceptable program of bacteriological and chemical surveillance and provide regular sanitary surveys of the water system. An adequate surveillance program would cost about $200 per system. The Bureau of Reclamation should also maintain closer control of the water systems around their reservoirs.

*Potable water, *Reservoirs, *Water quality, Water pollution control, On-site investigations, Analytical techniques, Chemical analysis, Bacteria, Monitoring, Water quality standards, State jurisdiction, Potable water, Water supply, Coliforms, Water treatment, Pollutant identification

Bacteriological analysis, Drinking Water Standards

J322
USE OF ENVIRONMENTAL ANALYSES ON WASTEWATER FACILITIES BY LOCAL GOVERNMENT,

Fensterstock, J. C., and Speaker, D. M.

Teknetron, Incorporated,
Washington, D. C.,
Applied Research Division.

July, 1974. 200 p, 10 fig, 7 append. PB 237 515.

The waste water treatment facility grant application process was analyzed as conducted at four case study sites: Jacksonville, Florida; Hot Springs, Arkansas; Nassau-Suffolk Counties, New York; and East Bay Municipal Utility District, California. Problems identified included: inadequate environmental orientation of the staffs, exclusion of lay public input, intra/inter-organizational conflicts, inadequate guidelines, and timing of environmental analyses for local consideration of consequences. It was found that environmental considerations played a relatively minor role in the decision-making process. Recommendations for local, state, and Federal implementation included: Federal funding to state and local agencies for training staffs, more precise Federal guidelines, legislative changes, and suggestions to increase public participation in the entire decision-making process.

*Treatment facilities, *Decision making, *Federal jurisdiction, *State jurisdiction, *Waste water treatment, Analytical techniques, Legislation, Construction costs, Training, Environmental effects, Local governments

Governmental funding

J323
INFLUENCES OF WASTEWATER MANAGEMENT ON LAND USE: TAHOE BASIN 1950-1972,

Pepper, J. E., and Jurgenson, R.

University of California,
Santa Cruz.

October, 1974. 167 p, 18 fig, 45 tab. PB 240 247.

Land use patterns in the Lake Tahoe, California, Basin were studied. Statistical analysis indicated that waste water infrastructure projects significantly influenced these patterns. In three out of four areas serviced by major waste water treatment facilities, land use densities increased immediately following the expansion of the treatment facilities. While water pollution control programs, developed by federal and state water quality agencies, removed the threat of water pollution for Lake Tahoe, provision of sewerage facilities also removed land development constraints. The rapid increases in land use have subsequently caused new environmental problems for the Tahoe Basin area. Recommendations for future water quality control on local, state, and federal levels are described.

*Water quality control, *Sewage treatment, *Waste water treatment, *Environmental effects, *Land use, Treatment facilities, Lakes, Water pollution control, Water management (applied), Administration

J324
CONTROL OF OIL AND OTHER HAZARDOUS MATERIALS,

Hyland, J. R.

June, 1974. 169 p. PB 238 096.

A course manual has been prepared for employees of regulatory agencies who are responsible for responding to nonrecurring discharges of oil. Hazardous materials are defined; procedures for personal safety during spill cleanup operations are detailed. Characteristics of various types of oils are described, including chemical and physical analyses, the biological effects of such pollutants, and the microbiology of petroleum. Water pollution control techniques by dispersants, sinking agents, burning agents, gelling agents, surface collecting agents, and sorbents are outlined. Oil water separator designs are also provided. Additionally, one chapter discusses the legislation affecting oil, national and regional contingency plans, and EPA oil pollution prevention regulation.

*Legislation, *Regulations, *Oil spills, *Oil wastes, *Separation techniques, Waste treatment, Analytical techniques, Training, Personnel, Environmental effects, Water pollution control, Pollutant identification

Training manuals, Oil pollution prevention

J325
MUNICIPAL WASTEWATER TREATMENT WORKS CONSTRUCTION GRANTS,

400+ pages, Compiled by the United States Environmental Protection Agency, Washington, D. C.

This manual was published as an interim aid until the "Construction Grants Manual" is issued (scheduled for 1976). This volume contains relevant program regulations, guidance, and technical information regarding the federal support of municipal waste water treatment facilities construction. Documents are grouped into six categories: construction grants and general grants; administration; provisions for environmental and social impacts and public participation; planning and state program assistance; permits and water quality monitoring; and other information. Legislation is detailed in copies of Federal Register articles. Several reference lists are also provided.

*Regulations, *Legislation, *Federal Water Pollution Control Act, *Waste water treatment, Treatment facilities, Construction, Costs, Water quality control, Monitoring, Federal jurisdiction, Publications

Construction grants program, Manuals

J326
STABILIZATION OF MUNICIPAL SEWAGE SLUDGE BY HIGH LIME DOSE,

Counts, C. A., Shuckrow, A. J., and Smith, J. E.

Pacific Northwest Laboratories, Battelle Memorial Institute,
Richland, Washington,
Water and Waste Management Section.

In: Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, May 21-22, 1974, New Brunswick, New Jersey, Rutgers University, p 73-125. 7 fig, 15 tab, 5 ref.

The degree of stability produced in sludges by the addition of large amounts of lime was determined initially in the laboratory and then in a large pilot plant. The effects of spreading lime stabilized sludges on land used for crop production were determined in small scale greenhouse studies and on larger outdoor plots. Initial laboratory studies were conducted to develop basic information on the lime stabilization process itself and to develop data for use in design and operation of a pilot plant. Lime requirements, time dependency of the lime/sludge reaction, and bacteria and odor reduction were studied, using primary municipal sludge mixed with humus. Chemical characteristics of the sludge and the method used to mix it determined the amount of lime required to raise the sludge pH. The lime sludge reaction caused a decrease in pH over time. Significant reduction in bacteria and odor were achieved by lime treatment. In pilot plant study, various lime doses were applied to raw sludge and system pH response was observed. The lime dose required to achieve a pH of 12 was affected by the chemical composition of the sludge. Bacteria was reduced by over 99%. Lime treatment also improved the sludge's settling characteristics. Application of sludge to a silt loam soil appeared to increase permeability with water and application to a sandy soil decreased permeability. Lime treated sludge did not significantly increase soil pH. Applied to cropland, it did increase the concentrations of nutrients available to the plants. When proper amounts of lime treated sludge were applied, soil productivity appeared to improve. Excessive concentrations of nutrients did not appear to be a problem.

*Municipal wastes, *Sewage sludge, *Stabilization, *Lime, Sludge, Land

J327
SLUDGE INCINERATORS IN USE TODAY THAT MEET THE REQUIREMENTS OF STATE AND FEDERAL REGULATIONS,

Kaercher, R. L.

In: Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, May 21-22, 1974, New Brunswick, New Jersey, Rutgers University, p 237-244.

Sludge incinerators from the point of view of a construction supervisor are discussed. The problems confronting sludge disposal today are the conditioning of the sludge into a suitable form for incineration and the disposal and control of the ash and emissions. Federal regulations are stated in the Clean Air Act. Limits of particulate matter emissions are 0.031 grains per dry standard cubic foot with opacity less than 10% except for two minutes every hour. Water vapor is excluded from these limits. New Jersey regulations prohibit visible ash and limit particulate emissions to 0.1 grains per dry cubic foot. Six types of sludge incinerators are operative in the United States: multiple hearth furnace; flash drying; wet oxidation; fluidized bed; incinerating a mixture of sludge cake and solid refuse; and the spray drying of sludge with excess heat from an incinerator and burning the sludge in the incinerator. Emission controls are of two types: the dry type including cyclones, electrostatic precipitators and bag filters; and the wet type, including impingement bafflers and venturi scrubbers. Although no regulations exist concerning odor, it must also be controlled. It has been found that multiple hearth furnaces and wet scrubbers are the most practical methods for incineration and air pollution control. Dangers exist in the individual interpretation of Federal regulations. Some latitude must also be made for interpretation in different areas.

*Sludge, *Incineration, *Regulation, Clean Air Act, Legislation, United States, Federal government, Sludge disposal, Air pollution, Ultimate disposal, Odor, Cyclones, Opacity, Water vapor, Sludge treatment, Waste treatment

On-site disposal, Particulate matter, Emission controls, Multiple hearth furnace, Flash drying, Wet oxidation, Fluidized bed, Bag filters, Electrostatic precipitators, Venturi scrubbers, Impingement bafflers, Sludge conditioning

J328
ECONOMIC CONSIDERATIONS FOR PLANNING SEWAGE SLUDGE DISPOSAL SYSTEMS,

Derr, D. A., Kasper, V., Jr., Gould, M., and Genetelli, E. J.

Cook College, Rutgers University,
New Brunswick, New Jersey,
Department of Environmental Science.

In: Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, May 21-22, 1974, New Brunswick, New Jersey, Rutgers University, p 245-266. 7 fig, 3 tab, 3 ref.

Procedures for the estimation and evaluation of costs for alternative sewage sludge disposal systems are suggested. Basic components or modes for sewage sludge disposal are identified. They are transport, dewatering, storage and site disposal. Land disposal can consist of dump truck, tank truck, rail or pipeline. Water transport can be either by barge or pipeline outflow. Dewatering is considered for the purpose of volume reduction so that cheaper transportation may be used. Three methods in common use are sand beds, centrifuge and vacuum filters. Sewage sludge can be stored at the sewage plant or at a disposal site. Disposal methods include incineration, land disposal, landfill, and ocean disposal. The flow of activity of sludge consists of three modes: the origin, the transport, and the destination. Land disposal offers the greatest opportunity for recycle into the soil. Ocean disposal can cut dewatering costs but may require additional transportation. Costs of sludge disposal can be placed into three categories: capital investment, operating or variable costs, and fixed costs. To evaluate alternative methods of sludge disposal, in addition to investment and cost data, consideration must be given to budgetary constraints, environmental impact and risk associated with each alternative. Cost estimates from previous research provided the basis for the hypothesized solution presented. The least expensive solution would be for a sewage treatment plant located at barge docking facilities to barge sludge at 5% solids for less than 30 miles to be dumped into the ocean. The most expensive is land transport for over 17 miles and land disposal.

*Economics, *Sewage sludge, *Sludge disposal, *Sludge, Planning, Disposal, Oceans, Storage

J329
EPA'S POSITION ON OCEAN DISPOSAL IN THE NEW YORK BIGHT,

Dewling, R. T., Spear, R. D., Anderson, P. W., and Braun, R. J.

In: Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, May 21-22, 1975, New Brunswick, New Jersey, Rutgers University, p 283-330. 12 fig, 13 tab, 1 append.

More than 70% of all municipal sludge and 60% of all industrial sludge is dumped in the area of the New York Bight. The Environmental Protection Agency became responsible for this area after the passage of the Maritime Protection, Research, and Sanctuaries Act in April, 1973, and since then significant changes have occurred. Eight industrial dumping applications/permits have been denied; forty seven dumpers were phased out and 12 additional were to be phased out by 1975; industrial waste and digestor cleanout must be dumped 106 miles offshore instead of 12 miles as before; and no new industrial or municipal dumpers have been approved since the Act was passed. A chemical and biological analysis of the wastes must be made by the dumpers and reported to the EPA; a vigorous enforcement program has been initiated with the help of the U. S. Coast Guard; and municipalities have been notified of the long range goal to completely phase out ocean dumping by 1981.

*New York, *Municipal wastes, *Industrial wastes, *Sludge disposal, Coast Guard regulations, Regulations, Waste disposal, Chemical analysis, Federal Government, Ultimate disposal, Permits

Environmental Protection Agency, Maritime Protection Research and Sanctuaries Act, New York Bight, Ocean disposal, Industrial dumping, Municipal dumping, United States Coast Guard

J330
DISPOSAL OF SEWAGE SLUDGE TO SEA; UNITED KINGDOM EXPERIENCE AND PRACTICE,

Portmann, J. E.

Ministry of Agriculture, Fisheries and Food, Burnham-on-Crouch, Essex, England, Fisheries Laboratory.

In: Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, May 21-22, 1974, New Brunswick, New Jersey, Rutgers University, p 331-348. 2 fig, 3 tab, 18 ref.

The experience of the United Kingdom in sewage sludge disposal to the sea is discussed. This has been common practice for large cities such as London, Manchester and Glasgow for over 50 years. Twenty five percent of all sewage sludge is presently dumped to the sea either by tanker or by outfall pipes. As land disposal becomes more costly and dangerous to crops, this amount is expected to increase. In the past, dumping practices have been voluntarily controlled by the Ministry of Agriculture, Fisheries and Food (MAFF). New legislation will soon come into effect as a result of the recent Oslo and London Dumping Conventions. An application will have to be made and licenses must be granted before dumping is allowed. A number of factors are considered for the selection of a dumping site. These include: navigational and operational aspects of the dumping area; safeguarding the deposits of sand and gravel for the construction industry; interference with recreation; the effects on marine resources; and the effects of toxic materials. A procedure is outlined to protect marine resources from the effects of pollution. Mathematical models and radioactive tracers are used to measure the different current flows and the rates of settlement of the solids in the sludge are determined from sludge density and particle size. Effects of the sludge on sediments, animals and fish are monitored. So far the program has been successful and only minor problems have arisen. Extensive studies conducted on the London, Glasgow and Manchester dumping grounds have shown little or no accumulations of organic matter, little metal accumulation and little or no change in species composition.

*Disposal, *Sewage sludge, *Sludge disposal, Ultimate disposal, Oceans, Toxins, Organic matter, Legislation, Mathematical models, Pollutants, Marine animals, Marine fish, Sediments, Radioactivity techniques, Tracers, Recreation

J331
EVALUATING THE IMPACT OF SLUDGE DISCHARGE TO SANTA MONICA BAY, CALIFORNIA,

Mitchell, F. K.

In: Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, May 21-22, 1974, New Brunswick, New Jersey, Rutgers University, p 417-433. 12 fig, 3 tab, 2 ref.

Physical, chemical and biological effects of sludge discharge to Santa Monica Bay, California, are discussed. Municipal waste water from the City of Los Angeles is discharged through two separate outfalls. A detailed characterization of the waste material being discharged was made. It was found that the digestion of the primary sludge resulted in significant reductions of total solids, volatile matter, chemical oxygen demand, and grease without affecting the concentrations of total nitrogen and total phosphorus. Mass emission rates of the sludge discharge are similar to those of the combined primary and secondary effluents. Physical and chemical properties of the ocean sediments in the bay have been altered by the waste discharges, with the greatest effects observed in Santa Monica Canyon and near the sludge outfall. Depth profiles of sediment heavy metals concentrations indicate that the depths of significant quantities of sludge particulates are greater than one foot near the sludge outfall and one foot or less at distances greater than two miles down canyon from the sludge discharge. Although the areas affected are not biological deserts, biological evidence of environmental stress in the vicinity of the discharges has been found.

*Evaluation, *Sludge disposal, *California, *Sludge, Municipal wastes, Sludge digestion, Solids, Chemical oxygen demand, Sediments, Metals, Nitrogen, Phosphorus, Environmental effects

Santa Monica Bay (Calif), Santa Monica Canyon (Calif), Los Angeles (Calif), Ocean disposal, Sludge outfall

J332
PRETREATMENT AND ULTIMATE DISPOSAL OF WASTEWATER SOLIDS,

May, 1974. 476 p, 106 fig, 84 tab, 195 ref. PB-239 868.

Fourteen papers have been published from a conference on the land disposal of sewage sludge. Topics included were: sludge handling and disposal; the stabilization of municipal sewage sludge by high lime doses; the thermal degradation of sludge; thickening characteristics of aluminum and iron primary sewage sludges; the dewatering of physical-chemical sludges; and the standards for sludge incinerators. Problems in sludge production and handling systems were also discussed. The Environmental Protection Agency's position on ocean disposal in the New York Bight was presented and economic considerations for the planning of a sewage sludge disposal system were outlined. Analytical methods were also proposed, such as bioassay for ocean sites and an evaluation of the impact of sludge discharge on an ocean bay.

*Publications, *Waste disposal, *Sludge disposal, *Sludge treatment, Legislation, Sewage sludge, Waste water treatment, Environmental effects, Planning, Bioassay, Dewatering

Conferences, Ocean disposal, Land application

886

J333
A SUPPLEMENTAL SOCIO-ENVIRONMENTAL DECISION TOOL: VALUE CONFLICTS ON LONG ISLAND,

Phillips, K. J.

Roy F. Weston, Incorporated,
Roslyn, New York.

Journal of Environmental Systems, Vol. 5, No. 2, p 103-113, 1 fig, 1 tab, 11 ref.

The groundwater quality of Long Island, New York, has deteriorated due to the cumulative effects of recharge through cesspools and septic tanks. In particular, increasing concentrations of nitrates have been measured at levels of up to twice the accepted health standards. To alleviate these conditions, a plan of replacing the individual waste disposal systems with sewers is being implemented. This paper focussed on value conflicts expected from the environmental impacts of the sewering plan. Values involving economics (costs of sewers and treatment facilities) and inconvenience and aesthetics (excavation, rerouting and detouring of streets) are juxtaposed with the values of health and convenience with the advent of an odor free and dependable waste disposal system.

*Groundwater, *Recharge, *Sewers, *Septic tanks, *Water quality control, Nitrates, Planning, Environmental effects, Costs, Public health, Waste disposal, Sewage treatment, Municipal wastes, New York

Value conflicts, Long Island (NY)

J334
AN ENGINEERING EMERGENCY: THE 1974 FLOODS,

Cossins, G.

Department of Water Supply and Sewerage,
Brisbane, Australia.

The Journal of the Institution of Engineers, Australia, Vol. 47, No. 7-8, p 20-23, July-August, 1975. 1 fig, 4 ref.

The effects of the 1974 floods on the Brisbane area of Australia are discussed. While hydrologists were busy forecasting levels, directing the operations of the flood mitigation dams and directing the measurement of flood flows, operation and maintenance engineers were occupied in securing the safety of municipal and public services. The flooding exceeded 20 meters in some areas and it lasted from a few hours in some areas to a few weeks in others. When the flooding reached its peak, activities changed from rescue to repair and rehabilitation of public facilities damaged by the flood. The objectives were to restore as rapidly as possible services of water supply, electricity, sewerage, communications and transportation. New structures were designed to replace those that had been destroyed by the flood. Funds to restore public facilities were readily available, but the private sector found it very difficult going and so work proceeded very slowly. The major lesson learned from the flooding was the need to bridge the communications gap between forecasters and public. One of the provisions built into the new flood warning scheme is the involvement of up to 300 personnel on a voluntary basis in the event of future floods. There are still two deficiencies to be worked out. The public should have access to flood records and maps as a matter of right and there is a need for a systematic study of the attitude of the public toward all aspects of flooding.

*Floods, Flood control, Flood damage, Flood forecasting, Warning systems, Flood flow, Flood peak, Australia, Public utilities, Repairing

Rescue, Brisbane (Australia)

887

J335
THE APPLICATION OF A SPILLWAY FOR RIVER FLOOD CONTROL,

van Beeston, C.

Thames Water Authority, United Kingdom.

Water Services, Vol. 79, No. 956, p 414-418, October, 1975. 5 fig, 14 ref.

The application of siphon spillways to river flood control in the Lee Valley, England, is discussed. The main control structures at present comprise gates of several types. The need for control of water levels within narrow limits between low and flood flows led to the concept of an air-regulated siphon type of control. The river system consists of river and navigation channels which are in some places combined. Certain minimum depths of water are required for shipping interests. Floods have occurred in this valley several times. The one in 1947 set the design for the present river system. Recent flooding in 1968 has prompted contracts for new improvements. These contracts provide improvement at the downstream end of the river in order to provide for the additional flow capacity created by new upstream works. The operation of the gates have undergone some problems during flood conditions when the required openings are not attained, due either to moving elements or motive forces or a combination of the two. Siphons, after originally being considered dangerous, were reevaluated and were found to be acceptable if floating debris were effectively excluded from the entrance and if additional discharge capability were provided. The siphon would be of the air-regulated type to avoid violent surging. An hydraulic model study of the siphon structure was conducted in the laboratory. This model study showed that the siphon was able to discharge large debris and had acceptable discharge characteristics.

*Flood control, *Spillways, *River regulation, Floodgates, Control structures, Siphon, Navigation, Channels, Flood flow, Model studies

Lee Valley (Eng), England, Hydraulic model study

J336
POLLUTION CONTROL AND SUGGESTED DISPOSAL GUIDELINES FOR CLINICAL CHEMISTRY LABORATORIES,

Clinical Chemistry, Vol. 21, No. 12, p 1839-1844, 1975. 7 tab, 6 ref.

Clinical chemistry laboratories may be discharging pollutants in considerable amounts. Surveys were conducted in hospitals in the Buffalo and Rochester, New York, metropolitan areas. Results showed that amounts of silver, arsenic, cyanide, chromium, copper, iron, mercury, zinc, acids, picrate and other organic solvents were being discharged. A stepwise procedure consisting of three phases was suggested on how to begin pollution control in clinical laboratories. The three phases were data collection, a short range remedial procedure and a long range remedial program. In the data collection phase four steps are required: a complete inventory of all liquid wastes of the laboratory should be made; an updated list of permissable levels of harmful pollutants should be obtained; the inventory of pollutants and the list of permissible levels should be cross-matched; and details of the laboratory sewer line must be determined. The short range remedial procedures consist of collecting the waste, disposing of the waste, obtaining a library of waste related reference material and cataloging and characterizing each waste according to its harmfulness and methods of disposal. The long range remedial program consists of devising methods that generate less pollutants, introducing new standards on hospital and equipment construction and safety, teaching ecology and safety consciousness to hospital personnel and offering and accepting the cooperation of other laboratories. Brief guidelines on waste disposal for different harmful wastes are given.

*Waste water disposal, *Chemicals, *Laboratories, *Disposal, Hospitals, Liquid wastes, Waste disposal, New York, Water pollution, Water pollution control

*Clinical chemistry laboratories, Disposal guidelines, Buffalo (NY), Rochester (NY), Permissible levels

J337
RATES AND MECHANISMS OF CHEMICAL REACTIONS DURING FLOW OF SECONDARY TREATED SEWAGE EFFLUENT THROUGH POROUS BEDS,

Uradnisheck, J. III.

Dissertation Abstracts International B, Vol. 36, No. 5, p 2377, November, 1975.

The rates and mechanisms of chemical reactions which occur as secondary treated sewage effluent flows through porous beds were studied. Experimental data show that the variation of aqueous cations in inorganic percolating solutions is the result of consecutive stages of rapid ion exchange of cations from the electric double layer followed by slow ion exchange of chemisorbed cations diffusing through aluminosilicate mineral structures. High concentrations of alkaline earth salts which remain in interstitial solutions when solution is drained from granitic sand are caused by desorption of cations from the sand by aqueous hydrogen ions. The hydrogen ions are generated by the conversion of adsorbed ammonium ions to nitrite ions by Nitrosomonas. A slight amount of mineral dissolution occurs. When a solution is again percolated through the sand, only a slight degree of nitrification accompanies the hydrogen ion desorption. A mathematical model is presented which can be used to predict the variation of aqueous calcium, magnesium, sodium, ammonium, nitrate, nitrite, oxygen, acidity, and bicarbonate ions as well as the bacterial population densities, adsorbed cations, and gaseous constituents of a soil column and solution as an intermittent percolation process is operated.

*Waste water treatment, *Sewage treatment, *Soil, Percolation, Chemical reactions, Ion exchange, Waste water disposal

J338
EVALUATION OF WATER LABORATORIES,

Public Health Service Publication No. 999-EE-1, 1972. 54 p, 2 append.

A major part of the Public Health Service Drinking Water Standards deal with laboratory methods and the technical competency of laboratory personnel. Bacteriological results may be accepted from State Health Department laboratories, local government laboratories, water works authorities, and commercial laboratories if these laboratories are approved for use by the Reporting Agency and the Public Health Service. This publication gives performance standards for the evaluation of the bacteriological laboratory procedures and equipment as required by the 1962 Edition of the Public Health Service Drinking Water Standards and the 12th Edition of Standard Methods for the Examination of Water and Wastewater. A survey form is included which is the official public health service form to be used in evaluating laboratories. Guidelines to be followed when making an evaluation are presented.

*Water analysis, *Laboratory tests, *Analytical techniques, *Public health, Potable water

J339
CLEARING UP THINKING ON POLLUTION LAWS,

Fannin, P. J.

In: Complete WateReuse: Industry's Opportunity, April 23-27, 1973, American Institute of Chemical Engineers and Environmental Protection Agency--Technology Transfer, p 48-58.

An address was given on the political aspects of water use. The tasks of a politician today are made difficult by various factors such as: the proliferation of scientific information; the abundance of people proposing new goals and regulations; and the influence of the mass media. Environmental legislation should follow a certain process; the problem should be determined; the costs to reach the solutions should be evaluated; and targets and a schedule that can be afforded should be set. A major concern should be the social and economic costs of environmental goals. The energy crisis should also be considered. Oil cannot be imported if prices on exports are inflated by the high costs of pollution control. Pollutant removal can have a negative environmental effect if too much energy and resources are required to remove pollutants and if more pollution is caused by the process. The cost of cleaning the final small fraction of pollutants can be exorbitant. Economic impacts of pollution control usually occur in small communities which can least afford them. Optimum solutions will result from the combination of economics, efficiency, and technology. The reuse of resources, including water is advocated. A discussion follows.

*Water utilization, *Water reuse, Legal aspects, Legislation, Water pollution control, Costs, Economics

Legislation effects

J340
THE RATIONALE OF ZERO DISCHARGE,

Parsons, W. A., and Azad, H. S.

In: Complete WateReuse: Industry's Opportunity, April 23-27, 1973, American Institute of Chemical Engineers and Environmental Protection Agency--Technology Transfer, p 34-36. 1 fig.

Although the concept of zero discharge is not new, its application is original and is a subject of critical evaluation from the standpoint of consistency with environmental goals and federal funding. Factors contributing to the realization of a full measure of benefit from expenditures committed to waste water control are reviewed. Water pollution is the utilization of the assimilation capacity of a watercourse. Assimilation capacity is a natural resource similar to solar energy, water supply or mineral deposits. Use of the assimilative capacity should not be considered evil if obtaining the fullest health, wealth and enjoyment is the goal. The most efficient pollution programs will prosecute all sources of pollution simultaneously so that equal unit cost of pollution removal is effected. Programs of proven practicality should be chosen over costly installations of unproven reliability. Zero discharge can be applied to situations in which water quality criteria is sublime, the waste treatment is a severe problem, or waste heat is a problem. However, it is not a viable concept in a program featuring cost optimization. Secondary effects on the environment should be evaluated. Amendments of existing legislation are needed to enable the adoption of policies consistent with national goals of conservation of natural and economic resources. The benefits are a more rapid alleviation of problems at minimum cost.

*Discharge (water), *Water utilization, Water pollution control, Water pollution, Natural resources, Water quality standards, Water pollution sources, Costs, Water reuse

*Zero discharge, Assimilation capacity

J341
SEPARATION OF ALGAE CELLS FROM WASTEWATER LAGOON EFFLUENTS BY SOIL MANTLE TREATMENT,

Gearheart, R. A., and Middlebrooks, E. J.

Utah State University, Logan,
Division of Environmental Engineering.

In: Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards, August 21-23, 1974, Logan, Utah, Utah State University, p 137-186. 6 fig, 24 tab, 204 ref. 1 app.

A review of the history of sewage disposal by waste water irrigation or soil mantle disposal of lagoon effluent is presented. An experimental design of a soil mantle disposal system is described. The limitations of pond effluent used as irrigation water for crops were investigated. Land planning techniques to make ponds more visually pleasing are studied. The difference between Class C and Class D Utah Water Quality Standards are given. The most significant difference is in the 5 day biochemical oxygen demand (BOD(5)). Class D is 25 mg/liter and Class C is 5 mg/liter. Class C standards in general cannot be met by waste stabilization ponds. Economically, they are very feasible, so another means of disposing of the effluent is suggested, irrigation. Waste stabilization pond depth, detention time, shape, mixing and loading are discussed. Too often, land planning has been neglected. It should be based on the nature of the site, and the human purposes for which it will be used. Planning techniques should account for odor, mixing by wind action, insects, type of site, water table depth, and topography. The use of natural berms and trees to reduce odors and attract insect eating birds should be considered. The beneficial or toxic effects of salinity, alkalinity, and other elements are discussed. Water quality factors in relation to specific crops are summarized. Land requirements for effluent discharge are also considered. Some case histories on the use of effluents for irrigation are briefly presented.

*Sewage treatment, *Waste water treatment, *Lagoons, *Effluents, *Algae, *Soil treatment, Soil filters, Water quality standards, Stabilization, Planning, Biochemical oxygen demand, Toxicity, Ponds, Land, Irrigation, Cost analysis, Crops, Utah

*Soil mantle treatment, Land planning, Utah Water Quality Standards

J342
LAGOON EFFLUENT SOLIDS CONTROL BY BIOLOGICAL HARVESTING,

Duffer, W. R.

Robert S. Kerr Environmental Laboratory,
Environmental Protection Agency, Ada, Oklahoma,
Water Quality Control Branch.

In: Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards, August 21-23, 1974, Logan, Utah, Utah State University, p 187-190. 14 ref.

Aerobic bacteria and algae are responsible for the stabilization of organic wastes in lagoons. Research has concentrated mostly on improving production of algae and phytoplankton, resulting in increased suspended solids concentrations, instead of trying to increase the bacteria population to consume the algae. Accomplishments of several studies oriented toward removal of phytoplankton by other aquatic organisms are reviewed. Problems associated with this biological harvesting are discussed, and research areas are suggested. Three types of organisms have been investigated: zooplankton, bivalve mollusks, and fish. Experiments that were performed using the zooplankton Daphnia indicated good suspended solids removal. Since the occurrence of this organism is very uncommon, culture ponds requiring rigid control and extensive management must be considered. Experiments performed with bivalve mollusks have shown algae removals of up to 85%. The use of cultured fish, mostly carp, in China has been practiced for centuries as a method of purifying waters. Various efforts in the United States included the use of carp, fathead minnows, fingerling channel catfish, golden shiner minnows, and Talapia nilotica. The best approach to date for the removal of solids in oxidation ponds has been the food chain concept. Larger scale systems must be experimented with. Additional research efforts should include: extent of selective solids uptake; examination of a greater number of species; taking a multi-species approach; study of seasonal aspects; productivity of culture systems; and the potential for problems.

*Lagoons, *Suspended solids, Biocontrol, Waste water treatment, Algae, Phytoplankton, Bacteria, Fish, Carp, Minnows, Channel catfish, Mollusks, Zooplankton, Food chains,

J343
BIG-METER TESTING PROGRAM BOOSTS WATER REVENUES,

Water and Sewage Works, Vol. 122, No. 12, p 36-37, December, 1975. 4 fig.

When the East Chicago, Indiana, Water Department tested large water meters in the area, it was found that four out of seven meters were less than 75% accurate. Within the municipality, there are major plant facilities in steel mills, foundries, oil refineries, and chemical industries which use about 311 million gallons of potable water per month. In addition, the residential and commercial use of potable water is about 312 million gallons per month. By a spot check on the industrial large water meters it was determined that some meters were frozen while others were old and obsolete. In some cases a single register compound meter could be installed. Replacement of four meters led to a revenue increase of $16,000 per year. In addition to the revenue increase, the city has found a sharp decrease in the amount of unaccounted-for water usage.

*Costs, *Water supply, *Industrial water, *Potable water, Chemical industry, Oil industry, Steel, Municipal water, Water consumption (except consumptive use), Water utilization, Treatment facilities, Economics

*Large water meters, Revenue collection

J344
CONTROLLING WATER POLLUTION,

Helmer, R.

World Health Organization,
Geneva, Switzerland,
Control of Environmental Pollution and Hazards.

WHO Chronicle, Vol. 29, No. 11, p 428-434, 1975.

The role of the World Health Organization (WHO) in all aspects of water pollution control is outlined. Sources of water pollution are described, including municipal, industrial and agricultural waste waters and urban runoff. Problems relating to water use, such as water supplies, recreational and agricultural uses, and water reuse are discussed. Water quality criteria and standards at an international level have been supported by the World Health Organization. A revision of the International Standards for Drinking-Water is being completed; guidelines detail minimal water quality requirements consistent with the health protection attainable in all member countries. WHO activities in water quality monitoring are also presented, involving the Global Environmental Monitoring System initiated by the United Nations Environment Programme (UNEP).

*Monitoring, *Water quality control, *Water quality standards, Water pollution control, Waste water (pollution), Industrial wastes, Storm runoff, Environmental effects, Potable water, Public health

World Health Organization

892

J345
HISTORY AND DEVELOPMENT OF AWWA STANDARDS,

Richardson, W. H.

Alvord, Burdick & Howson,
Consulting Engineers,
Chicago, Illinois.

American Water Works Association Journal, Vol. 67, No. 11, Part 1, p A33-A37, November, 1975. 1 fig, 4 tab.

The standardization program of the American Water Works Association (AWWA), which has been ongoing for 100 years, includes standards as well as books, manuals, and handbooks developed by the organization. The definition of a standard is presented as, "something established for use as a rule or basis of comparison in measuring or judging capacity, quantity, extent, value, or quality." The AWWA Standards Council has been responsible for the development of publications on standards; currently one book, five manuals and 69 existing standards are being reviewed and two new manuals and 28 new standards are being developed. A listing of present AWWA standards is providing, defining materials, substances, products, equipment, systems, procedures, and services as they relate to the water supply field. Proposed new standards on steel pipe, plastic pipe, swing check valves, and prestressed water tanks are also discussed. Additionally, the development of the 14th edition of Standard Methods for the Examination of Water and Wastewater is summarized. AWWA standards program offers benefits to the manufacturer, the engineer, and the consumer.

*Waste water treatment, *Water treatment, *Standards, *Publications, Water pollution control, Construction, Pipes, Engineering

*Manuals, American Water Works Association standards

J346
CONSTRUCTION PROCEDURES AND REVIEW OF PLANS AND GRANT APPLICATIONS,

Uhte, W. R.

Brown and Caldwell,
Walnut Creek, California.

In: Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards, August 21-23, 1974, Logan, Utah, Utah State University, p 21-29.

General problems connected with waste water stabilization ponds and the design, construction, and operation considerations which are involved in federal and state review are discussed. Problems can arise when oxidation ponds are not designed properly, are not operated and maintained properly, and are not budgeted for and funded properly. Design considerations are the responsibility of the design engineer. Loading levels should be flexible to assure excessive summer organic loadings and winter hydraulic loading. Properly designed pond configuration involves recycling from four to eight times the average design flow into the system. Inlet and outlet hydraulics should be designed for peak wet weather flows. The system should be designed so that areas where scum tends to accumulate are eliminated. Pond and channel dikes are usually best when designed with side slopes between 6 horizontal to one vertical and 2 horizontal and one vertical. Boat launching ramps with all weather access, wash and toilet facilities, and laboratory and monitoring facilities should be built. For the construction of a pond, the contractor must be provided with a clear and concise set of drawings and specifications which complement each other. The design engineer should have the full responsibility for the resident engineer and the inspection of the project. The design engineer should provide an operation and maintenance manual which describes: the treatment processes; the physical layout; process testing; maintenance requirements; safety restrictions; and emergency procedures. Operation training programs, performance evaluations and user charges and self sufficiency may also be required of the design engineer.

*Construction, *Lagoons, *Oxidation lagoons, Waste water treatment, Stabilization, Design criteria, Engineering personnel, Ponds, Design, Operation and maintenance

J347
FINANCING AND MANAGEMENT OF THE PROPOSED SEWERAGE SCHEME FOR JAIPUR TOWN,

Kachwaha, M. S.

Public Health Engineering Department, Rajasthan, Jaipur, India, Planning Circle.

Journal of the Institute of Engineering (India), Vol. 55, Part PH3, p 73-75, June, 1975. 2 tab, 1 app.

The proposed sewerage scheme for Jaipur City, India, is discussed. In 1963-64, a scheme was designed for 610,000 people at a cost of Rs 2.04 crores. Since this has already been surpassed, a new scheme has been designed for the estimated 1991 population, 12.5 hundred thousand people, at a new cost of Rs 14.95 crores. It is assumed that as many sewer connections will be needed as there are water connections. It is hoped that unsewered city residents would accept a sewer connection at a price of Rs 450, since the costs of soak pits and septic tanks are more and these provide only temporary relief. It is desirable to levy development charges on existing plots for providing sewerage systems. Considering estimates of residential land in 1991, this can produce capital receipts of over Rs 90 million. Capital receipts from commercial and industrial land are estimated at Rs 47 million. Considering population and sewer increases by 1991, connection charges will result in almost Rs 22 million in capital receipts. It is proposed that the Public Health Engineering Department of the State will run, maintain, and manage the completed scheme. The scheme is proposed to be completed by 1979-80. New sewer connections will be spread out over the years at an average of about 3,350 per year. It is concluded that the scheme would not only be viable but would also be self-supporting.

*Sewerage, *Sewers, *Financing, *Management, Capital, Municipal wastes, Costs

*Jaipur City (India), *India

J348
WATER-SAVING DEVICES: THE STATE OF THE ART,

Sharpe, W. E., and Fletcher, P. W.

The Pennsylvania State University, University Park, School of Forest Resources.

DE Journal, p 11-13, 15, October, 1975. 2 fig, 5 ref.

Predictions of water needs are in need of revision because of the change in the country's energy needs. Water conservation must be practiced to alleviate this problem as well as the unnecessary treatment of large amounts of waste. Methods of water conservation, such as new pricing, universal metering, and public education, are generally only temporary solutions. Water saving devices can accomplish the same goals cheaply and without major disruptions in water use habits. The impact and cost effectiveness of various water saving devices are discussed. Studies have shown that water use reductions on the order of 20% resulted when devices were installed on resident owned dwellings. Reductions were insignificant where tenant landlord situations prevailed and in commercial establishments. Waste flow reduction efforts on infiltration-inflow correction can account for more than 30 to 40% of the sewage flow reaching the treatment plant. For on-lot sewage disposal systems, water saving devices can produce a 40% reduction in sewage flows. A 26% reduction was found when a waste water recycling system was used with septic tanks. A study showed that an estimated 560,000 barrels of oil could be saved daily with the efficient use of hot water. The increased concentrations of solids that would result from waste flow reductions could have an adverse effect on sewage systems that are designed to carry small loads, but generally this problem is thought to be insignificant. Studies have shown that water saving devices such as shower flow controls, and toilet inserts are cost effective on new and old homes. A limitation is their availability.

*Water conservation, Energy, Costs, Sewage, Water utilization, Efficiencies, Wastes

894

J349
ZERO DISCHARGE TO THE ENVIRONMENT OF DIFFICULT WASTEWATERS,

Elshazly, M. A.

In: Complete WateReuse: Industry's Opportunity, April 23-27, 1973, American Institute of Chemical Engineers and Environmental Protection Agency--Technology Transfer, p 147-151. 1 fig.

Contaminated waste waters from the chemical processing industry vary so much in composition that treatment by chemical or biological methods is very difficult. Such wastes were previously dumped in deep wells, dumped in the ocean, or incinerated. A multi-evaporation process, called the Carver-Greenfield process, has been used in the food processing industry successfully and is now finding application in the recycling and ultimate disposal of chemical wastes. Oil is added to the liquid waste and the water is evaporated. The resulting moisture free oil-solid suspension is separated by centrifugation. Since tighter environmental standards have made the cheaper methods of disposal ecologically unsound, the Carver-Greenfield process previously considered too costly, is becoming a viable alternative. Two types of waste streams are considered. The first is 20,000 lbs/hr with 7% dissolved organic material from a pharmaceutical manufacturer, and the second is 117,000 lbs/hr, containing 9% oil and 3% solids from an oil refinery. In the first plant, incineration was adopted at a cost of 169,000 dollars. If the Carver-Greenfield process were used, it would cost 92,000 dollars per year. In the second plant, incineration costs 1,018,500 dollars, while the Carver-Greenfield process costs 350,000 dollars.

*Waste water (pollution), *Waste water disposal, *Waste water treatment, *Chemical wastes, Industrial wastes, Oil, Costs, Incineration, Evaporation, Organic matter Ultimate disposal, Water reuse

Carver-Greenfield process, Waste streams, Multi-evaporation process, Zero discharge

J350
STAGONOSPORA FOLICOLA, A PATHOGEN OF REED CANARYGRASS SPRAY-IRRIGATED WITH MUNICIPAL SEWAGE EFFLUENT,

Zeiders, K. E.

Plant Disease Reporter, Vol. 59, No. 10, p 779-783, October, 1975. 1 fig, 1 tab, 10 ref.

A field of reed canarygrass (Common) which was spray irrigated with municipal sewage effluent was found to have a foliar disease resembling tawny blotch. Adjacent fields of reed canarygrass with no irrigation had no disease. This occurrence prompted an investigation of the etiology of the disease and studies of the pathogen. The causal fungus, taken from infected reed canarygrass, was isolated from diseased tissue and identified as S. foliicola. Two tests were then made to determine conditions favorable for infection and disease development. Potted ramets of Common reed canarygrass from the irrigated field were inoculated by spraying with a conidial/mycelial suspension of S. foliicola until thoroughly wet. In the first test plants were kept in various combinations of chamber, temperature, and exposure periods, and it was found that disease development was better in plants kept 72 hours in a dew chamber. In the second test, time-of-exposure in a dew chamber was varied, and again disease development was better in plants given a 72-hour incubation period. Of eight species inoculated, only one, P. arundinacea, was susceptible to the disease. These studies indicated that the build-up of tawny blotch on reed canarygrass will be favored by two factors: plants remaining uncut throughout the growing season so that more leaves are exposed to inoculum of the fungus for a prolonged period of time, and periods of three days of cool weather and abundant moisture for infection and disease development to be initiated. The effect of the plant nutrients in the effluent water on disease development was not known because there were no areas irrigated with "pure" water for comparison.

*Sewage effluents, *Irrigation, *Waste disposal, Waste water (pollution), Water pollution effects, Fungi, Plant pathology

J351
GOVERNMENT-CONTRACTOR-ENGINEER LIASON THAT CREATES AN ECONOMICAL PROJECT,

von Buchstab, V.

Engineering and Contract Record, Vol. 88, No. 13, p 40-42, Fall, 1975. 1 fig.

The York-Durham water and sewer project in the Toronto region is under construction and will support 170,000 new homes and increased industrial development. The project is unusual because contractor-owner-engineer negotiations are being conducted and the contracting industry has been asked to contribute input to the final specs before official bidding. This liason between government, contractors, and engineers should help develop economic and viable construction methods. The contracting industry is in close contact with equipment suppliers and tends to be knowledgeable about improvements in technology. In addition, when bids are put out during slow business periods, they tend to be more carefully written. Additionally, the advent of a standardization policy has helped in coordinating discussion and planning recommendations.

*Sewers, *Water treatment, *Treatment facilities, *Construction, *Economics, Engineering, Construction equipment, Governmental interrelations, Sewage treatment, Planning

Canada, York Durham water and sewer project

J352
REVEGETATING BITUMINOUS STRIP-MINE SPOILS WITH MUNICIPAL WASTEWATER,

Edgerton, B. R., Sopper, W. E., and Kardos, L. T.

Pennsylvania State University,
University Park,
Forest Hydrology Department.

Compost Science, Vol. 16, No. 5, p 10-15, Autumn, 1975. 1 fig, 4 tab, 5 ref.

Stripmining causes acid mine draining that can result in a sterile aquatic ecosystem. In order to try to ameliorate the toxicity and acidity of strip-mine spoil, a study was conducted on the changes effected by effluent and sludge irrigation on spoil material. In a model study, boxes of highly toxic spoils were planted with legume and grass seeds, and irrigated with amounts of effluent and sludge. Upon analysis of spoil and leachate chemical composition, it was found that effluent and sludge treatment of the spoil material could ameliorate the conditions of toxicity and acidity. Leachate nitrogen levels may be increased, however, resulting possibly in detrimental eutrophication of waterways.

*Waste disposal, *Sludge disposal, *Toxicity, *Land reclamation, Model studies, Environmental effects, Irrigation, Leachates, Nitrogen, Waste water (pollution), Eutrophication

Renovation, Acid mine drainage, Land application

J353
A FRAMEWORK FOR EVALUATING INSTITUTIONAL AND SOCIO-ECONOMIC ISSUES OF LAND TREATMENT OF WASTE WATER,

Christensen, L. A.

Economic Research Service,
United States Department of Agriculture,
Upper Darby, Pennsylvania,
Natural Resource Economics Division.

Journal of Environmental Quality, Vol. 4, No. 2, p 145-153, April/June, 1975.
1 fig, 1 tab, 27 ref.

Land treatment involves the application of waste water to vegetation producing land for adsorption of nitrates and phosphates by soil and plants. To encourage a multidisciplinary approach to land treatment planning, some institutional and socio-economic issues are highlighted here through a discussion of alternative means of acquiring and managing land treatment sites. If a public agency purchases the land by fee simple acquisition, management can be handled by subcontracting for custom farm operations, or the land can be leased to farmers. The land can also be resold for private use with some legitimate conditions. Easement purchase, or partial property rights purchase, is another alternative which has the advantage that management is left in the hands of the private owner. A new approach to land access is municipal and private cooperative ownership with division of management costs. Some examples are given of existing systems and their management.

*Waste water disposal, *Nutrient removal, *Regional planning, Land management, Land development, Management

Land application, Socioeconomic planning

J354
EARTHWATCH,

Jensen, C. E., Brown, D. W., and Mirabito, J. A.

National Oceanic and Atmospheric Administration,
Rockville, Maryland,
Deep Water Ports Project Office.

Science, Vol. 190, No. 4213, p 432-438, October 31, 1975. 6 fig, 1 tab, 22 ref.

Earthwatch, part of the United Nations Environment Program, is a four-part program involving monitoring, research, evaluation, and information exchange. The program, which was created in June, 1972, will provide the basis for global environmental management and supporting measures. The monitoring aspect of Earthwatch will be done at stations all over the world and in conjunction with organizations already established by the United Nations. Research activities include atmospheric research, and oceanic exploration. Information exchange will complement the activities and services already provided by the World Data Center. Eventually the framework for Earthwatch will be nongovernmental assessment centers around the world.

*Monitoring, *Data collection, *Research and development, *Information exchange, Environmental effects, Water pollution, Air pollution

*Earthwatch

J355
THE DEVELOPING ROLE OF WATER AUTHORITIES,

Slade, G. D.

South West Water Authority,
Great Britain,
Exeter Division.

Chartered Municipal Engineer, Vol. 102, No. 11, p 211-215, November, 1975. 3 fig, 6 ref.

Population increases, food production increase demands, industrial relocation, increased housing demands, more recreation, redistribution of wealth, and better communications all exert pressures on the newly-established Water Authorities in Great Britain to provide more water, main drainage, land drainage, and water-space amenities. The interplay between national, regional, and local resources is complicated. Already the regional Water Authorities must evaluate themselves and their relations with national and local contacts. Broader national policies and more co-operation between regions must be accepted. A composite management/structure type committee to assess the reorganized system and the two Royal Commission reports is recommended. In the development of the Water Authorities, important guidelines for future policies can be established.

*Administration, *Water resources development, Comprehensive planning, Regional planning

J356
WATER QUALITY MANAGEMENT FOR METROPOLITAN KANSAS CITY,

Schmidt, O. J.

Black and Veatch, Consulting Engineers,
Kansas City, Missouri.

Journal of the Environmental Engineering Division - ASCE, Vol. 101, No. EE6, p 935-946, December, 1975. 5 fig, 3 ref.

Lack of centralized sewerage planning for metropolitan areas has resulted in problems of inadequate facilities, untrained operators, and expensive duplication costs. This study of the metropolitan Kansas City water treatment systems points to the new and much-needed trend toward unified water treatment planning and management for metropolitan areas. The specific problems encountered in the Kansas City metropolitan area were watersheds crossing state lines and differing policies of the two states for treatment. Seven options for managing the eight counties on both sides of the Kansas-Missouri line were developed by Black & Veatch, Consulting Engineers. These options include organizing a water management agency for the entire metropolitan area, organizing agencies along county lines, and organizing agencies along watershed districts. Because interstate cooperation might still be difficult to achieve, a combination county-watershed system of agencies was thought to be the most appropriate. Although legislation already exists allowing interstate management, more legislation may be needed to strengthen this power. Whatever design is chosen, it is recommended that the number of management agencies be reduced to as few as possible and that cooperation in planning and operating be encouraged.

*Water quality control, *Sewerage, *Planning, Kansas, Missouri, Municipal wastes, Municipal water, Waste water treatment, State jurisdiction

Kansas City (Mo)

J357
THE FUTURE OF WATER RESOURCES,

Jackson, K.

Wessex Water Authority,
Wessex, England.

Chartered Municipal Engineer, Vol. 102, No. 11, p 216-218, November, 1975.

Because of the prediction that by the end of the century demand for public water supplies may double, the newly established Water Resources Board of England and Wales has had to consider long-term schemes for supplying water. At present, river abstraction and regulation of river flow provides most water supplies. In heavily populated areas such as London, water from a river outside the area, such as the River Severn, may have to be piped to the Thames to regulate the flow and increase the London water supply. One such scheme is already under way: a link between the rivers Tyne, Wear, and Tees will supply the Northumbrian Water Authority area with water until the end of the century. Another form of river regulation being developed involves pumping water from underground strata to augment the river flow. This plan is currently being developed to augment the River Thames. Artificial recharge is a solution that involves feeding surface water into underground strata to improve the yield of boreholes sunk into the aquifer. This system utilizes natural storage as opposed to costly manmade storage. The idea of developing estuary storage by the construction of barrages is thought to be prohibitively expensive. Desalination is also too expensive to warrant use in England. Low-quality water supplies could be piped to industries and good quality sources could be reserved for drinking water. Combinations of these solutions could provide sources in excess of the sum of the separate yields if each source is operated in isolation.

*Water sources, *Water supply, Water management (applied), Administration, Rivers, Aquifers, Groundwater, Surface waters, Desalination, Recharge

Water Resources Board (England and Wales)

J358
DEALING WITH THE DISCHARGE MONITORING REPORT,

Holm, J. D.

Water and Sewage Works, Vol. 122, No. 12, p 62-63, December, 1975. 4 fig.

Some problems of the discharge monitoring report, EPA Form 3320-1 (10-72), were solved by the San Antonio Waste Water Treatment Plant. A work sheet, a smaller, more concise version of the EPA Form, was prepared on 8-1/2 by 11 inch paper. Examples of the large form and the work sheet are reproduced in the article. A form letter, also reproduced in the article, was then prepared for weekly reports. Details of reporting and recording are given. For plants which have not yet made the calculations for the biochemical oxygen demand and the total suspended solids loadings, the computation is as follows: the effluent quantity in mgd is multiplied by the parameter effluent concentration in mg/liters; that product is then multiplied by a conversion factor of 3.785 to obtain the loading in kg/day. The conversion factor results from multiplying 8.345 pounds per gallon by 0.4536 kilograms per pound.

*Monitoring, *Legislation, *Waste water treatment, *Treatment facilities, Biochemical oxygen demand, Suspended solids, Water quality control

EPA discharge monitoring report, Effluent discharges

J359
DETERGENT PHOSPHATE BAN YIELDS LITTLE PHOSPHORUS REDUCTION, PART III,

Etzel, J. E., Bell, J. M., Lindemann, E. G., and Lancelot, C. J.

Purdue University,
Lafayette, Indiana,
Department of Environmental Engineering.

Water and Sewage Works, Vol. 122, No. 11, p 68-70, November, 1975. 1 fig, 2 tab, 11 ref.

The legislative ban on detergent phosphates in Indiana has failed to reduce the remaining stream phosphorus to levels low enough to be of any biological significance. The results of the 1974 study that reveal the failure are detailed in tables and a graph. Whether or not the actual phosphorus concentration has been decreased is debateable but not the real issue. What is significant is that the ban limitations are still too high to limit algal growth. In addition, the ban on detergent phosphates may have confused the public of the overall objective. The idea that chemical precipitation is solely a phosphorus removal step is a misunderstanding. Chemical precipitation greatly increases the removal of all nutrients, including residual BOD, from treated sewage. The elimination of detergent phosphates alone has not upgraded the quality of treated water. Other phosphorus reductions must also be made, and chemical flocculation steps are needed in all treatment systems if the State's water quality standards are to be met.

*Water quality control, *Legislation, *Phosphates, *Detergents, *Indiana, Biological treatment, Sewage treatment, Water pollution effects, Chemical precipitation, Flocculation

Legislative bans

J360
HEALTH SIGNIFICANCE OF AIRBORNE MICROORGANISMS FROM WASTE WATER TREATMENT PROCESSES, PART II: HEALTH SIGNIFICANCE AND ALTERNATIVES FOR ACTION,

Hickey, J. L. S., and Reist, P. C.

North Carolina University,
Chapel Hill,
Department of Environmental Science and Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 12, p 2758-2773, December, 1975. 4 tab, 77 ref.

The emission and spread of viable bacterial aerosols from aerated waste water processes has been demonstrated in numerous studies. These aerosols contain a variety of virulent, pathogenic, bacterial genera and species in particles within the human respirable size range for both upper and lower respiratory tract deposition. Present evidence does not, however, confirm or negate the existence of a health risk. Further investigation of health effects is necessary, and concurrent development and evaluation of viable aerosol control measures could be helpful. Environmental monitoring is not of much value without further studies on the health aspects of aerosols. Nonetheless, waste water plant operators and health professionals should be informed of the potential risks from waste water aerosols. These conclusions were drawn from an overall assessment of the results and conclusions of studies into the airborne microorganisms. The studies included field and laboratory investigations, reviews, and surveys from 1907 to 1975.

*Public health, *Treatment facilities, *Aerosols, Bacteria, Pathogenic bacteria, Path of pollutants, Air pollution

Aerated waste water treatment, Air pollution sources

J361
HEALTH SIGNIFICANCE OF AIRBORNE MICROORGANISMS FROM WASTEWATER TREATMENT PROCESSES, PART I: SUMMARY OF INVESTIGATIONS,

Hickey, J. L. S., and Reist, P. C.

North Carolina University,
Chapel Hill,
Department of Environmental Sciences and Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 12, p 2741-2757, December, 1975. 54 ref.

This report summarizes 16 published reports representing 13 separate field studies, all that could be found in English, of airborne microorganisms from waste water treatment processes. The earlier studies, from 1907 to the 1950's, established that bacteria was spread by aerosolization from waste water flowing in sewers, sludge aeration tanks, and trickling filters. In 1966, it was shown that trickling filters yielded twice as many coliforms as other plant units, and that half the particles were less than 5 microns in diameter. In a different test, it was calculated that this particle size could penetrate the lungs and that the number of small particles increased with some distance from the waste water sources. Later it was decided that the small aerosols could penetrate both the bronchia and the upper respiratory tract. Aerosol dispersion patterns, taking into consideration the direction of wind, were made. In 1973, a test was undertaken in which bacteria were recovered from various airs around a plant and guinea pigs were inoculated with the organisms. Within 6 weeks the guinea pigs developed lesions. Another study concluded that solar radiation, low relative humidity, and low wind speed reduced aerosol emissions. One report suggested that coliforms may not be a reliable index of air pollution arising from waste water aeration and that total colony count may be a more accurate measure. Some of the reports made conclusions about possible health hazards, but the totality of the significances on health are summarized in the second part of the article.

*Public health, *Aerosols, *Treatment facilities, Bacteria, Pathogenic bacteria, Coliforms, Air pollution, Path of pollutants, Reviews

Air pollution sources, Aerated waste water treatment

J362
CONTROLLING POLLUTION FROM COMBINED SEWERS,

Linsley, R. K.

Simulation Network Newsletter, Vol. 7, No. 5, p 1-4, July 1, 1975. 4 fig.

If the 1985 target for pollution control is to be met, billions of dollars must be spent for storage facilities for sewage flows awaiting treatment. Determination of the required storage capacity is a hydrologic and economic problem. The Hydrocomp Simulation Program (HSP) is a continuous flow simulation that can give the most accurate estimates for storage requirements and configurations possible. HSP can also define the probability that the discharge of pollutants into receiving waters would exceed limits. If they did not, storage could be reduced. Since such probabilities would vary, even within the period of a day, the program must be produced very rapidly and accurately. The principle of flow storage is similar to that of flood control by reservoirs. The major differences are that the projected costs of flow storage are three times the expenditures to date on flood control, and that there are few records of sewer flows that can be used for design purposes. These factors necessitate the use of careful planning from simulated models.

*Storage capacity, *Sewage treatment, *Hydrology, Economics, Model studies, Economics, Flow, Simulation analysis, Flood control, Planning

Hydrocomp Simulation Program (HSP)

J363
HOW THE GREAT LAKES WERE EVALUATED,

Sonzogni, W. C.

Great Lakes Basin Commission,
Ann Arbor, Michigan.

Environmental Science and Technology, Vol. 9, No. 10, p 929-928, October, 1975.
1 tab.

The Great Lakes Basin Framework Study produced 6,000 pages of report and appendices to provide a broad-scale analysis of resource needs and problems in the U. S. portion of the Basin. This article gives a brief description of the report and its 23 appendices (divided into six general categories). The first part concerns alternative frameworks. The second set of appendices give basic resource information. Water resources use and management is the topic of the third category. Land resources use and management is the fourth category. The fifth discusses economic, social, and institutional studies, laws, and policies, and the sixth discusses environmental quality. The main report is a general summary of the appendices. In addition, an Environmental Impact statement and a special critique of the Framework Study were prepared. The statement summarizes the impacts and possible adverse effects of the Framework Study's plans. A group of governmental agencies and public interest groups critically examined the issues and questions which arose from the Framework Study. The report provides information for scientists, engineers, planners, and conservationists.

*Great Lakes region, Water management (applied), Planning, Data collections, Government supports, Legislation, Environmental effects

J364
PHOSPHATE SORPTION CHARACTERISTICS OF SOILS TREATED WITH DOMESTIC WASTE WATER,

Sawhney, B. L., and Hill, D. E.

Journal of Environmental Quality, Vol. 4, No. 3, p 342-346, July/September, 1975.
5 fig, 4 tab, 14 ref.

The capabilities of six widely different Connecticut soils to sorb phosphate was studied in laboratory tests. Samples of the soils were suspended in phosphate solutions and their saturation times were measured. With that information the traveling time of the phosphate in the soils was calculated. Soil cores of the six soils were then leached with phosphate solutions on a weekly basis for two years. It was found that because of the great variance in sorption capacities, the saturation time requirements varied greatly. Over time the soils did not become fully saturated, suggesting that the soils were regenerated. These observations were substantiated by field studies around septic tank drainfields, one of which had been in operation for 15 years and still showed sorption capabilities. In addition, treatment of acid oils with waste water was found to increase their pH, thereby increasing their CEC and capacity to remove cationic pollutants from waste water. Thus it was concluded that soils around septic tank systems can remove phosphate effectively and for an indefinite length of time.

*Nutrient removal, *Soils, *Phosphates, *Sorption, Laboratory tests, Septic tanks, Soil mechanics, Waste water treatment, Environmental effects

Soil saturation

J365
EFFECT OF SEWAGE SLUDGE ON SOME SOIL PHYSICAL PROPERTIES,

Epstein, E.

United States Department of Agriculture,
Beltsville, Maryland,
Agricultural Environmental Quality Institute.

Journal of Environmental Quality, Vol. 4, No. 1, p 139-142, January/March, 1975.
7 fig, 2 tab, 10 ref.

The effect sewage sludge application to soil has on soil water retention, hydraulic conductivity, and aggregate stability at 15, 25, and 35 C for 175 days, was determined by weight measurement and the presence of pH and carbon. Raw sludge retained twice the amount of water retained by digested sludge. The two digested sludge treatments (high and low pH) retained approximately 10 times more water than the soil control. With higher temperatures, available water decreased with time and reached equilibrium faster, suggesting that the changes in water retention were related to microbial activity. However, the total carbon contents of the soil-sludge mixtures did not change greatly. Although hydraulic conductivity varied among sludge soil samples initially, after 79 days the hydraulic conductivity was essentially the same. The percent stable aggregates for sludge treatments after 175 days were essentially the same, averaging 34%, compared to 17% in untreated soil control. Temperature had little effect on aggregate stability. This information could affect decisions on disposal of municipal wastes. Rather than dumping sludge into landfills or the ocean, or burning sludge in incinerators, sludge could be added to soil, producing greater soil stability, water infiltration, and water movement.

*Sludge disposal, *Sewage sludge, *Soil physical properties, Soil water, Waste disposal, Hydraulic conductivity

*Land application

J366
TRACE ELEMENT CONCENTRATIONS OF SEWAGE TREATMENT PLANT EFFLUENTS AND SLUDGES; THEIR INTERACTIONS WITH SOILS AND UPTAKE BY PLANTS,

Bradford, G. R., Page, A. L., Lund, L. J., and Olmstead, W.

California University,
Riverside,
Department of Soil Science and Agricultural Engineering.

Journal of Environmental Quality, Vol. 4, No. 1, p 123-217, January/March, 1975.
1 fig, 8 tab, 18 ref.

The variety and concentrations of trace elements in effluents and sludges from certain metropolitan areas were identified and their interactions with soils and effects on plant growth were evaluated. Seven secondary treatment plants in southern California were selected for bimonthly analyses of the effluent over a 10-month period. The concentrations of Cu, Zn, Ni, Co, and Cd were consistently higher in the sludge samples than those obtained in ordinary California soils. Analysis of barley, bean, and tomato plants grown in sand culture and irrigated with aqueous sludge extracts was done to demonstrate the variability of absorption of different elements from sludge sources. Excessive and often toxic concentrations of B, Cu, Mo, Ni, Co, and Cd were found when compared to the concentrations in the control plants irrigated with a complete nutrient solution. Variabilities of different elements from different sludges are presented in a table.

*Sludge disposal, *Trace elements, Soil contamination effects, Treatment facilities, Effluents, California soil analysis, Toxicity, Water pollution effects, Waste water (pollution)

Sludge toxicity

J367
OXYGEN RELATIONSHIPS IN A SOIL TREATED WITH SEWAGE EFFLUENT,

Klausner, S. D., and Kardos, L. T.

Journal of Environmental Quality, Vol. 4, No. 2, p 174-178, April/June, 1975.
1 fig, 4 tab, 15 ref.

The effects of applying chlorinated, secondary sewage effluent on two aeration parameters, oxygen diffusion rate and concentration of oxygen in the soil gas, were studied. The effects of applying the sewage effluent on several chemical parameters which may be affected by differing aeration conditions, notably, the concentrations of NH4+, NO3-, and NO2- nitrogen, and iron and manganese in the soil water, were also evaluated. Water samples and oxygen diffusion and concentration measurements were taken on a weekly basis from a loamy field watered with secondary treated sewage effluent during a four-year rotation of oats, hay and corn. The concentration of nitrogen, iron, and manganese was analyzed weekly from the soil water samples. As weekly application of effluent changed from 0 cm to 2.5 cm to 5.1 cm, average gaseous oxygen concentrations to a depth of 46 cm ranged from 19.6 to 19.0 to 18.4%. Oxygen diffusion rates (ODR) were not significantly different for the three effluent levels but values diminished with depth with a minimum of 15 at 46 cm and a maximum of 27 at 8 cm. Gaseous oxygen concentration was not affected by crop cover but ODR was less under hay than under corn. Water samples obtained at depths of 15.2 and 61 cm showed that nitrite levels were very low. Ammonium-N levels were greater in the 5.1 cm effluent treatment but there were no differences due to vegetation cover or soil depth. Manganese and iron levels were not affected by effluent treatment. The weekly 5.1 cm application of sewage effluent did not degrade the aeration condition of the soil.

*Soil analysis, *Sewage disposal, *Effluents, Aeration, Oxygen, Ammonium, Nitrogen, Irrigation

*Land application, Oxygen diffusion rates

J368
HOW TO IMPROVE PLANT EFFICIENCY,

Gilbert, W. G.

Water and Sewage Works, Vol. 122, No. 11, p 58, November, 1975.

A compilation of reports from surveys conducted over three years revealed that about one-third of the nations's municipal treatment facilities constructed with Federal grant assistance are not operating at their designed efficiency levels. To improve the efficiency and reliability of treatment facility performance, local, state and Federal programs must establish tighter control and monitoring. Operators must be well trained and certified. Violations of permit limitations must be pursued aggressively and corrected. Operational expertise must be applied to the planning and design levels. Plant performances must be monitored and evaluated. New and simplified laboratory procedures must be tested. Adequate operating budgets at the local level must be provided. Proper operation and maintenance of existing plants is essential for reaching and maintaining effluent quality standards.

*Waste water treatment, *Treatment facilities, *Municipal wastes, *Monitoring, Government finance, Water quality standards, Legislation, Performance

J369
MANAGEMENT OF AN EFFECTIVE MAINTENANCE PROGRAM,

Kerri, K. D., and Brady, J.

California State University,
Sacramento,
Department of Civil Engineering.

Water and Sewage Works, Vol. 122, No. 11, p 56, November, 1975.

Improper operation and maintenance of waste water collection systems can create many problems. Untreated waste water flowing down streets and water courses during stoppages and storms can cause health hazards. Lack of proper installation, preventive maintenance, surveillance, and repair programs can result in system failures. The collection system, lift stations, and treatment plants can produce odors. Shock loads that upset treatment processes can occur. Equipment and structures can become corroded. Use of a valuable portion of the capacity of the facilities can be taken up by inflow and infiltration. Problems from system failures can result in complaints from the public or from local officials. To effectively operate and maintain a waste water treatment plant, managers must establish a good set of procedures for planning and recording the activities of the maintenance program. Managers must also train their maintenance forces to apply these programs.

*Waste water treatment, *Operation, *Maintenance, *Storm runoff, Treatment facilities, Inflow, Infiltration, Water management (applied), Administration

J370
NUTRITIONAL AND PHYSIOLOGICAL EFFECTS OF NITRATES,
NITRITES, AND NITROSAMINES,

Shirley, R. L.

Florida University,
Gainesville,
Department of Animal Science.

BioScience, Vol. 25, No. 12, p 789-794, December, 1975. 81 ref.

Areas of high concentrations of livestock, heavy fertilizer application, septic tanks, and sewage plant outflow may produce excessive quantities of nitrates in animals' drinking water and eutrophication of lakes. Nitrates and nitrites consumed in diets of animals are being studied as toxic factors for the animals. Ruminants have greater tolerance of nitrate and nitrite than human infants, but a potential danger still exists. Nitrates have been demonstrated to lessen formation of toxins when added to meat products that contain various toxin-producing microbes. On the other hand, in the presence of various amines in meat and other foodstuffs, nitrites have been demonstrated to produce carcinogenic nitrosamines. Bacteria in the alimentary tract produce nitrosamines from nitrite and amines derived from lecithin and proline. Because experimental doses exceed the concentrations that normally appear, it is not known whether the potential sources of nitrosamines have actually produced cancer in animals. Tests on rats showed that nitrosamines produced cancer in the digestive, urinary, and respiratory tracts, as well as in the liver and reproductive tissues.

*Septic tanks, *Waste water treatment, *Fertilizer, *Sewage treatment, *Lakes, Nitrates, Nitrites, Eutrophication, Toxicity, Potable water, Animal diseases

Nitrosamines, Carcinogens

J371
EFFECTS OF SALINITY ON NITRIFICATION IN THE EAST RIVER,

Chen, M., Canelli, E., and Fuhs, G. W.

New York State Department of Health,
Albany,
Environmental Health Center,
Division of Laboratories and Research.

Journal Water Pollution Control Federation, Vol. 47, No. 110, p 2474-2481, October, 1975. 3 fig, 3 tab, 25 ref.

Due to known high concentrations of ammonia and nitrite from discharges of waste water treatment plants into New York Harbor, a study was done to determine the rate of nitrification in the East River and to determine the NaCl tolerance of the nitrifying bacteria. Water samples were collected from 12 sites along the East River each week for about three months. Media were prepared with the river dilutions to represent the concentrations of calcium, magnesium, phosphorus, and iron in the undiluted East River water. The samples were incubated for 20 days and then portions were used as inocula. Colonies were selected and streaked twice for isolation. The results of chemical analysis showed that the rates of nitrification in samples from the East River are increased when the samples are diluted with suitable media prepared with distilled water. The rates of nitrification in samples from the southern or central parts of the East River are higher than those in samples near the sound. Both NaCl and some unknown substances in the filtrate portion of the water seem to inhibit nitrification in the East River. Nitrifying bacteria isolated from the East River were not halophilic. Most nitrifying bacteria in the East River are therefore apparently of terrestrial origin.

*Ammonia, *Nitrites, *Waste water treatment, *Nitrification, New York, Sampling, Bacteria, Rivers, Salinity, Environmental effects, Chemical analysis

East River (NY), Waste assimilation

J372
RELATIONSHIP BETWEEN VARIOUS BACTERIAL POPULATIONS AND COPROSTANOL AND CHOLESTEROL,

Dutka, B. J., and El-Shaarawi, A.

Canada Centre for Inland Waters, Department of Environment,
Burlington, Ontario, Canada,
Scientific Operations Division.

Canadian Journal of Microbiology, Vol. 21, No. 9, p 1386-1398, September, 1975. 3 fig, 9 tab, 19 ref.

Since fecal matter in water can carry hazardous viruses, finding traces of coprostanol and cholesterol in raw waters, indicating the presence of fecal matter in water, could be important to public health. A one-year study evaluated the relationship between coliforms, fecal coliforms, fecal streptococci, heterotrophs, and coprostanol and cholesterol. Sewage samples were collected from four treatment plants, one that chlorinated clarifier effluent, one that chlorinated water before flocculation and added lime to the clarifier tank, one that chlorinated final effluent, and one that chlorinated raw sewage. Water samples were analyzed bacteriologically, and fecal sterol samples were analyzed chemically. Reduction in fecal-sterol levels ranged from 46.93% to 99.81%. A significant relationship existed between coprostanol and cholesterol in all three phases of the sewage-treatment processes. No significant relationships were found to exist between fecal sterols and bacterial parameters in the raw-sewage streams. However, in treated unchlorinated sewage a significant relationship was observed between most bacterial parameters and fecal sterols. A statistical model using the collected data indicated that coprostanol and cholesterol have a high positive correlation, thus supporting the concept that either sterol could be used as an indicator of fecal pollution.

*Viruses, *Model studies, *Coliforms, *Bacteria, *Public health, Treatment facilities, Flocculation, Sampling, Statistical analysis

*Coprostanol, *Cholesterol

J373
INSTRUMENTS FOR WATER AND SEWAGE TREATMENT PLANTS (Jogesuido keiso kiki),

Sekimoto, K., Nakakuma, K., Ito, M., Hayashi, T., and Hashimoto, H.

Toshiba Rebyu, Vol. 30, No. 11, p 804-808, October, 1975. 10 fig, 3 tab.

The expansion of the scale of water supply and waste water treatment has increased the importance of control equipment for these applications. Descriptions are presented for the newest instruments for water supply and sewage treatment control systems. The equipment includes high-precision electromagnetic flowmeters, maintenance-free water quality sensors, and water meters for centralized reading.

*Water supply, *Waste water treatment, *Equipment, *Instrumentation, Control, Control systems, Monitoring, Measurement, Automation

J374
FULL AUTOMATION GOAL OF WATER RECLAMATION PLANT,

Flanagan, M. J.

Water and Wastes Engineering, Vol. 12, No. 12, p 19-24, 58, December, 1975. 5 fig, 3 tab.

A system of distributed digital processors and peripheral equipment is employed for data acquisition, process control and data management in a new 30 mgd water reclamation plant. The process control and management information system is currently undergoing factory testing prior to delivery to the plant site. The entire digital system was connected to an analog computer programmed on a real time basis to simulate portions of the waste water treatment process. The system is built around a hierarchical network of digital computers consisting of two minicomputer systems and 24 microcomputer systems. The cost of the system, including all field instrumentation and telemetry equipment, represents 4.0% of the total plant construction cost. The system can be expanded whenever the plant is expanded. Both computer systems are provided with a real-time operating system so that either system can be assigned to real-time process control. The computers will regulate the functions of the plant processes, log operational data, schedule a maintenance program, keep an inventory, assign personnel, and store and retrieve historical data. The alarm system works in such a way that the operator is only informed of abnormal functioning. The plant in which the computer system will be installed is a physical-chemical-biological process and incorporates lime clarification in the primary sedimentation tanks, biological nitrification-denitrification, and a two-stage centrifugal classification and clarification process with recalcining and lime recovery. The denitrified plant effluent is filtered by a multimedia rapid sand filtration system and chlorinated prior to distribution for reuse by industry.

*Computers, *Data processing, *Control systems, Treatment facilities, Waste water treatment, Water reuse, Biological treatment, Automatic control, Construction costs

Water reclamation plant, Physico-chemical treatment

J375
DYNAMIC WATER QUALITY MANAGEMENT STRATEGIES,

Lettenmaier, D. P., and Burges, S. J.

Washington University,
Seattle,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 47, No. 12, p 2809-2819, December, 1975. 1 fig, 1 tab, 14 ref.

A total management system designed to meet water quality standards includes physical system dynamics, management system dynamics, and measures of the state of the physical system. Physical system dynamics, as applied to a water quality system, include the interactions of biochemical, microbiological, and hydrodynamic elements that determine the relationship between inputs and outputs. Management system dynamics describe the management relationship used to achieve transition to desired states of the physical system. The primary role of management is to provide the necessary control mechanisms to the system element inputs to ensure that the physical system activities produce outputs that satisfy the management objectives. The dynamics of both the physical and the management system for a reach of river can be represented by several fundamental system control methods. One would be to increase the upstream flow if impoundment existed. Another would be to use the results of in-stream monitoring to control discharges. Direct measurement of effluents may also lead to direct control of the effluents themselves. Combinations of these systems methods might be necessary. To manage water quality effectively, it is necessary to determine the response of the physical system to a given set of waste loads. This may be done: by simulating the response of the physical system without regard to causative factors; by simulating the response by direct modeling of system dynamics; or by simply assembling a historic record of waste inputs.

*Water quality control, *Data collections, *Rivers, Simulation analysis, Water management (applied), Systems analysis, Waste water (pollution), Model studies, Water pollution control

J376
USE OF SEWAGE SLUDGE ON AGRICULTURAL LAND AND THE EFFECTS OF METALS ON CROPS,

Williams, J. H.

Agricultural Development and Advisory Service,
Wolverhampton, England.

Water Pollution Control, Vol. 74, No. 6, p 635-644, 1975. 10 tab, 7 ref.

Sewage sludges, and particularly liquid digested sludges, are valuable sources of available nitrogen and phosphate, if they are applied in spring when the growing crop can utilize them. Sewage sludge containing industrial wastes must be applied carefully, and sludges that may be toxic are unsuitable for agricultural use. Once a harmful concentration of these toxic metals is built up in soils, the effect can be permanent. Zinc and nickel are absorbed by plant roots and translocated within the plant. Copper becomes concentrated in the roots. Very little of the total lead in the soil is absorbed by plants and it remains in the roots; although it does not seem to affect plant growth, it could harm animals or humans if abnormal amounts are accumulated. Although not enough is known about the behavior of mercury and cadmium, cadmium probably is a risk because it is readily taken up by the roots, and mercury probably is not because its percentage in sludge is so small.

*Sewage sludge, *Nitrogen, *Phosphate, *Fertilizer, Toxicity, Heavy metals, Soils, Zinc, Nickel, Copper, Lead, Mercury, Cadmium, Environmental effects, Industrial wastes

Land application

J377
PRACTICAL RESEARCH IN WATER POLLUTION CONTROL,

Forster, C. F.

University College,
Cardiff, England,
Department of Microbiology.

Water Pollution Control, Vol. 74, No. 6, p 625-634, 1975. 7 fig, 5 tab, 24 ref.

Relative to problems in the waste water treatment industry, particularly aspects of sludge bulking, nitrification, and sludge disposal, some current fields of research are discussed. The settling characteristics of sludge have a considerable influence on the quality of final effluent. Deterioration in the settling properties of activated sludge, or bulking, is an ever-present threat to treatment plants. There are two theories on the causes of bulking: one is that a bulked sludge is one that has become grossly infected by filamentous microbes, and the other is that bulking is due to variations in the surface of the sludge. As a result of studies based on the latter theory, it has been suggested that the accumulation of lysozyme sensitive material in the sludge caused by the death of bacteria could be one cause of bulking. Another cause could be the depolymerization of slime layer polysaccharide. Since present standards for discharge are inadequate and the amount of nitrogenous matter converted to ammonia must be minimized, nitrifying systems are being studied. One solution calls for a separate nitrifying system in which the biomass is composed more or less exclusively of nitrifying bacteria and in which the sludge age is high. Another solution is submerged filtration in which there is a co-current flow of liquid and air upwards through a packed bed upon which the nitrifying flora develops. For the disposal of waste sludge, two possibilities show commercial potential. One use is the supplementation of animal feed, and the other is conversion into fermentation feedstock.

*Waste water treatment, *Research and development, Activated sludge, Treatment facilities, Bacteria, Water pollution control, Nitrification, Sludge disposal

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